Section 7 Consultation Package –

National Marine Fisheries Service

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

SEP 05 2012

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

Mr. David Bernhart
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
263 13th Ave South
St. Petersburg, Florida 33701

Dear Mr. Bernhart:

This letter and associated information package supplements the consultation requests provided to your office on March 25, 2002 and September 17, 2004 for the Port Everglades Feasibility Study.

The U.S. Army Corps of Engineers, Jacksonville District (Corps) is currently conducting a feasibility study to assess the Federal interest in cost sharing the recommended navigational improvements and their continued maintenance. This assessment includes evaluation of engineering, environmental and overall economic effect of the proposed project. The Feasibility Study was congressionally authorized by a resolution of the House Committee on Transportation dated May 9, 1996.

The Recommended Plan main elements include:

a. deepen and widen the Outer Entrance Channel (OEC) from an existing 45-foot project depth over a 500-foot channel width to 57 feet* by 800 feet and extend 2,200 feet seaward;

b. deepen the Inner Entrance Channel (IEC) from 42 feet to 50* feet;

c. deepen the Main Turning Basin (MTB) from 42 feet to 50* feet;

d. widen by approximately 300 feet the rectangular shoal region to the southeast of the MTB (Widener) and deepen to 50* feet;

e. widen the Southport Access Channel (SAC) in the proximity of berths 23 to 26, referred to as the knuckle, by about 250 feet and relocate the United State Coast Guard (USCG) facility, easterly on USCG property;

f. shift the existing 400-foot wide SAC about 65 feet to the east from approximately berth 26 to the south end of berth 29 to provide a transition back to the existing Federal channel limits;

g. deepen the SAC from about berth 23 to the south end of berth 32 from 42 feet to 50* feet;

h. deepen the Turning Notch (TN), including the expanded portion from 42 feet to 50* feet with an additional 100-foot north-south widening parallel to the SAC channel on the eastern edge of the SAC over a length of about 1,845 feet and widen the western edge of the SAC for access to the TN from the existing Federal channel edge near the south end of berth 29 to a width of about 130 feet at the north edge of the TN;

(*All dredging depths have an additional two feet of potential dredging added to them for overdepth – one foot of required overdepth and one foot of allowable overdepth).

i. construct environmental mitigation for unavoidable, minimized impacts;

j. pre-treat rock substrates as necessary and take appropriate measures to safeguard protected species during that process;

k. dispose of dredged material not used for mitigation construction east of the Port at the Offshore Dredged Material Disposal Site (ODMDS), which is currently proposed for expansion by USEPA. If it is not expanded, the maximum amount of material that can be placed within the existing site will be deposited, and alternatives will be explored for the deposition of remaining material (NEPA coordination to that effect are currently underway).

Enclosed please find the Corps' Biological Assessment of the effects of the proposed project on listed species in the action area. Attached to this Biological assessment are the following:

a. A chronologic history of the consultation
b. September 17, 2004 Biological Assessment
c. March 25, 2002 Biological Assessment
d. August 28, 2008 – Meeting Notes from *Acropora* Survey Meeting held in St. Petersburg
e. March 26, 2008 – Letter from NMFS to Marie Burns regarding need for Acropora survey
f. October 18, 2006 – Letter from Marie Burns to David Bernhart regarding USACE effects determination for *Acropora.*
g. October 13, 2006 - Letter from NMFS to Marie Burns regarding USACE effects determination for *Acropora.*
h. August 18, 2006 – Letter from NMFS to Terri Jordan regarding USACE Reef Assessment Report.
i. Benthic Habitat Characterization for the South Florida Ocean Measurement Facility. Protected Stony Coral Assessment. Prepared by NOVA SE University. December 2011.
j. Port Everglades Feasibility Study *Acropora* Coral Survey Final Report. October 2010.
k. Benthic and Fish Community Assessment at Port Everglades Harbor Entrance Channel. December 2009.
l. Environmental Baseline Study and Impact Assessment for Port Everglades Harbor. Final Report. May 31, 2001
m. Seagrass Mapping and Assessment Port Everglades Harbor. Final Report. October 5, 2006
n. Seagrass Mapping and Assessment Port Everglades Harbor. Final Report. December, 2009

Although all of this material has been previously provided to your staff over the 10-year course of this consultation, due to staff changes, etc., per your request in addition to the *Acropora* specific information, we are providing a complete copy of all materials associated with the consultation in one.

We request continuation and completion of consultation under section 7 of the Endangered Species Act concerning the effects of the proposed action on listed-species under NMFS' jurisdiction and any designated critical habitat.

If you have any questions, please contact Ms. Terri Jordan-Sellers at 904-232-1817 or Terri.Jordan-Sellers@usace.army.mil.

Sincerely,

Jason J. Spinning
Chief, Coastal Section
Environmental Branch

Enclosure

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CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT- PORT EVERGLADES NAVIGATION PROJECT

The Corps is supplementing the ongoing consultation under Section 7 of the Endangered Species Act (ESA) for the Port Everglades expansion project. Specifically this Biological Assessment (BA) addresses potential effects of the proposed harbor expansion project to the *Acropora sp.* corals and designated critical habitat (DCH) during project construction. The original consultation for this project was initiated by letter dated March 25, 2002 (logged into NMFS system as F/SER/2002/00626) and amended by letter dated September 17, 2004. That consultation assessed the effects of the proposed project on green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balenoptera musculus*), humpback, (*Megaptera novaeangliae*), sei (*Balaenoptera borealis*), fin (*Balenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*). A summary of each species is restated in this assessment with new information added where applicable and the reader referred to the original information included in the previous consultation documents.

This additional supplement is triggered by the listing of Acroporid corals as threatened and designation of critical habitat under the ESA, as required by 50 CFR 402.16(d). Per agreement with National Marine Fisheries Service (NMFS) during an April 28, 2008 meeting, the Corps and NMFS would move ahead with the consultation.

Consultation History

A detailed history of the consultation is included in the Consultation package, appendix 1 and is incorporated by reference. The Corps also incorporates the meeting notes from the April 23, 2008 meeting between NMFS-PRD leadership and CORPS staff and leadership concerning the path forward with regard to the consultation and the listing of *Acropora* species. The meeting notes are found in Appendix 4 of the consultation package. In 2010, CORPS was able to conduct *Acropora* surveys utilizing the new protocol for deep draft navigation harbors developed with NMFS in response to the April 2008 meeting.

Project Location

Port Everglades (Port), located in Broward County, is the seventh largest seaport on the Atlantic coast of the US and located on the southeast coast of Florida (Figure 1). It is located within the cities of Hollywood, Dania Beach, and Fort Lauderdale, with immediate access to the Atlantic Ocean. The entrance of the Port is approximately 27 nautical miles north of Miami Harbor, Florida and 301 nautical miles south of Jacksonville Harbor, Florida. The existing authorized Port Everglades Federal Navigation Project provides for an Outer Entrance Channel (OEC) that is 45 feet deep and 500 feet wide (Figure 2), an Inner Entrance Channel (IEC) that is 450 feet wide and 42 foot deep, a Main Turning Basin (MTB) that is 42 feet deep, a North Turning Basin (NTB) that is 31 feet deep, a South Turning Basin (STB) that is 31 to 36 feet deep, a Southport Access Channel (SAC) that is 390 to 400 feet wide and 42 feet deep, and a Turning Notch (TN) that is 42 feet deep.

Figure 1 - Location of Port Everglades Harbor

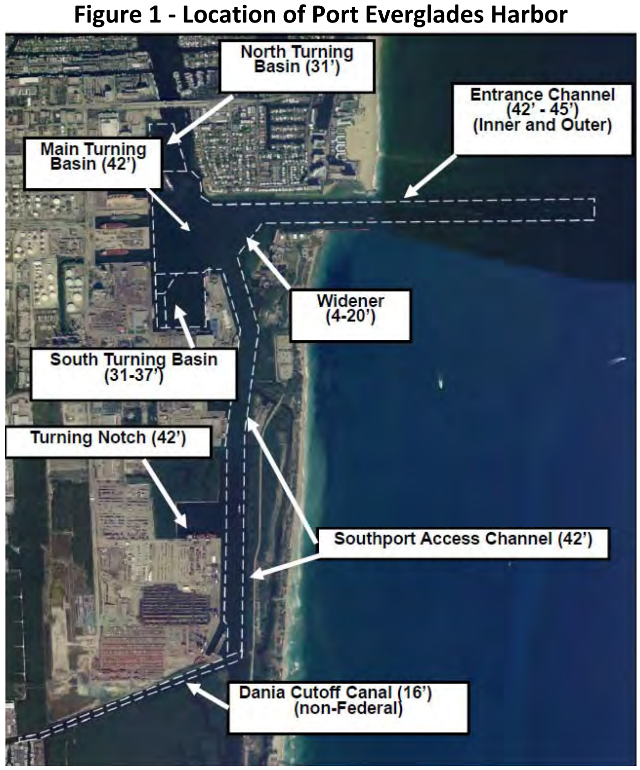


Figure 2 - Existing Project Components

Figure 3 shows Port-associated facilities and berths. To the east of the Port is a barrier island that contains a U.S. Navy (USN) facility, the Nova Southeastern University Oceanographic Center (NSUOC) , a U.S. Coast Guard (USCG) facility, and John U. Lloyd Beach State Park (JUL) and its adjacent beaches. South of the Dania Cutoff Canal (DCC) is the West Lake Park area. West of the Port is Federal Highway which is flanked by the Fort Lauderdale/Hollywood International Airport. North of the Port is a mixture of small craft waterways and commercial and residential development.

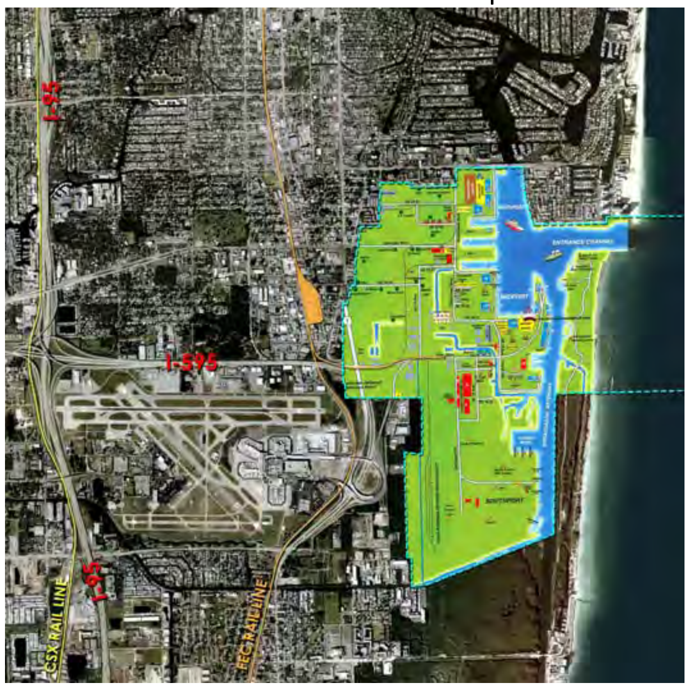


Figure 3 - Existing Port Infrastructure and Surrounding Properties

The port was originally dredged by private interests between 1927 and 1928. The first modifications to Port Everglades were authorized by Congress in 1930 and since then, several additional modifications to accommodate larger vessels have been congressionally authorized or federally permitted (1935, 1938, 1946, 1958, 1974, 1980 and 1989). Additionally, various berths and channels in Port Everglade have been maintenance dredged over the last 25 years (Table 1).

Table 1 - O&M Dredging History of Port Everglades

Year	Area Dredged	Dredge Company	Volume (CY)	Disposal Area
1971	S Turn Basin	Hendry Corp.		Present Berth 29 Area
1978	Slips 1,2,3	Ajax Co.	60,000	Present Berth 29 Area
1979	S Turn Basin	Merritt Dredging	120,000	Present Berth 29 Area
1980	Slips 1,3	Powell Bros.	40,000	Present Berth 29 Area
1991	Slip 1	Southport Dredging	9,782	Dockside-trucked off port
1994	Slip 3	Frenz Enterprises	7,000	Dockside-trucked off port
2000	Slips 1,2,3	Subaqueous Services	11,053	Southport-used as backfill
2004	slip 3	Shoreline Foundation	200	Dockside-use for rip rap
2005	Slip 3, Berth 21,22	Subaqueous Services	7,335	Southport-used as backfill
2005	North Turning Basin 7+60 to 18+67	Great Lakes Dock & Dredge	60,210	ODMDS
2005	Outer Entrance Channel	Great Lakes Dock & Dredge	547,000	John U Lloyd State Beach Park
2007	Berth 29	Subaqueous Services	8,070	Southport- used as backfill

Description of the Proposed Action

After twelve years of development, review, analysis and component minimization, the Tentatively Selected Plan (TSP) has been selected. The Project will require the removal of approximately five (5) million cubic yards of shallow sands and massive, hard rock. Features of the current TSP, (Figure 4), include;

a. extending the Outer Entrance Channel (OEC) 2,200 feet seaward with an 800-foot wide flare, and deepening the existing 500-foot wide OEC from 45 feet to 57 feet, plus one foot of required overdepth and one foot of allowable overdepth for a total of 59 feet;
b. deepening the Inner Entrance Channel (IEC) from 42 feet to 50 feet, plus one foot of required overdepth and one foot of allowable overdepth for a total of 52 feet;
c. deepening the Main Turning Basin (MTB) from 42 feet to 50 feet plus one foot of required overdepth and one foot of allowable overdepth for a total of 52 feet;
d. widening the rectangular shoal region southeast of the MTB (Widener) by approximately 300 feet and deepening it to 50 feet plus one foot of required overdepth and one foot of allowable overdepth for a total of 52 feet;
e. widening the Southport Access Channel (SAC) in the proximity of berths 23 to 26 (the knuckle) by approximately 250 feet and relocating the USCG facility, easterly on USCG property;

f. shifting the existing 400-foot wide SAC approximately 65 feet to the east near berth 26 to the south end of berth 29 to transition from the knuckle area widening to the existing Federal channel limits;
g. deepening the SAC from approximately berth 23 to the south end of berth 32 from 42 feet to 50 feet plus one foot of required overdepth and one foot of allowable overdepth for a total of 52 feet;
h. deepening the Turning Notch (TN), including the Port Authority planned expansion (if completed by the port), from 42 feet to 50 feet plus one foot of required overdepth and one foot of allowable overdepth for a total of 52 feet, with nearby widening including (1) widening the eastern edge of the SAC 100 feet along a 1,845 stretch parallel to the SAC and (2) widening the western edge of the SAC for access to the TN from the existing Federal channel near the south end of berth 29 to a width of about 130 feet at the north edge of the TN, and
i. Deepening the port's berthing areas adjacent to the federal channel and basins.

Figure 4 - Tentatively Selected Plan

Overview of Dredging and Rock Pre-Treatment Methods

Based on geotechnical boring data from the entrance channel, sand, silt, clay, and rock of varying hardness are expected to be encountered in the entrance channel. Sand, silt, clay, soft rock, rock fragments, and loose rock will be removed via traditional dredging methods. Where hard rock is encountered, the Corps anticipates that contractors will utilize other methods, including confined blasting or large cutterhead dredge equipment to pre-treat the rock prior to removal. Blasting will be implemented only in those areas where standard construction methods, including large cutterhead dredges, are anticipated to be unsuccessful. Dredged material will be deposited at two locations. Some rock and coarse materials will be transported by barge and may be placed at an artificial reef site as potential compensatory mitigation for unavoidable and minimized impacts to reef/hardbottom communities. The balance of rock and coarse materials that cannot be beneficially utilized for mitigation will be transported to the Offshore Dredged Materials Disposal Site (ODMDS).

Five separate dredging and pre-treatment methodologies may be utilized in the deepening and expansion of the port's channels and basins. Each one will be evaluated separately since they rely on differing equipment, and thus different effects may occur. Construction methodology of the project will be determined by the contractor selected by the Corps during the bid process. However, certain assumptions can be made regarding various techniques that may be needed to complete construction; those assumptions are the basis for this consultation. If an alternative construction methodology, not included in this consultation is proposed by the selected contractor, that result in effects to the species under NMFS' jurisdiction that are different than those analyzed here, the Corps will reinitiate consultation.

Dredging equipment is classified as either hydraulic or mechanical based upon the means of transporting the dredged material from the channel bottom. Hydraulic dredges use water to pump the dredged material as slurry to the surface and mechanical dredges use some form of bucket to excavate and raise the material from the channel bottom. The most common hydraulic dredges include cutter-suction and hopper dredges and the most common mechanical dredges include clamshells and backhoes (also referred to as marine excavator or dipper dredges). In addition to clamshell and backhoe dredges, mechanical dredges also include bucket ladder dredges, however, US law requires that dredges working on federally funded projects have US built hulls and no large scale bucket ladder dredges capable of conducting rock dredging are currently available for US work. Various project elements influence the selection of the dredge type and size. These factors include the type of material (rock, clay, sand, silt, or combination); the water depth; the dredge cut thickness, length, and width; the sea or wave conditions, vessel traffic conditions, environmental restrictions, other operating restrictions; and the required completion time. All of these factors impact dredge production and as a result costs. Multiple dredges of the same or different types may be used on projects where conditions vary between dredging locations or to expedite the work.

The following discussion of dredges and their associated impacts will be limited to potential dredging equipment suitable for the Port Everglades deepening project. The key project elements for this deepening project include:

- Material is primarily rock, much of which is classified as hard to very hard and may require pretreatment (such as blasting) prior to dredging.
- The widening areas include an overburden of silt, sand, and soft rock over the hard rock areas.
- Significant environmental resources including reefs are located adjacent to project.
- Project includes open water dredging in a channelized environment.
- Project depth is -50 MLLW plus 7 feet of underkeel clearance + 1 foot required overdepth +1 foot allowable overdepth for a total dredge depth of 59 feet in the outer entrance channel and -50 MLLW + 1 foot required overdepth +1 foot allowable overdepth for a total dredge depth of 52 feet in the inner channels and basins.

Dredged material will most likely be excavated using either a hydraulic cutterhead dredge or mechanical excavator with some or all of the material pretreated using confined blasting or some other method to break the hard rock prior to dredging. If a mechanical dredge is used, the larger dredged material may be removed and segregated at the construction site for use in constructing the mitigation sites. Larger rock material will be placed on one barge/scow to be transported to an artificial reef site, while other materials would be placed on a separate barge/scow for placement in the offshore disposal site. In any event, disposal of all dredged material would be in the ODMDS and/or an artificial reef site. Any unconsolidated material in the channel (beach quality sand) that may have filled in the channel south of the south jetty, may be removed by a hopper dredge and placed in accordance with the Environmental Assessment for Operations and Maintenance Dredging completed with a Finding of No Significant Impact signed on April 28, 2005, that the Corps completed two ESA consultations for in 2004 and 2012, both resulting in concurrence with the Corps' determination that O&M dredging of Port Everglades was either already covered by the 1997 South Atlantic Regional Biological Opinion (NMFS, 2004) or a determination that placement of beach quality O&M material, "may affect, but is not likely to adversely affect" listed species under NMFs' purview. Additionally, NMFS concurred that the placement of beach quality O&M material was not likely to adversely modify designated critical habitat offshore of the dredged material placement area, John U Lloyd state park (NMFS, 2012).

The project scale limits potential equipment to large-scale hydraulic or mechanical dredges. Potential equipment must be able to reach 55 to 60 feet in depth, depending upon wave and tide conditions as well as excavate large material volume.

<u>Hydraulic Dredges</u>

Hydraulic dredges are characterized by their use of a pump to dredge sediment and transport slurry of dredged material and water to identified discharge areas. The ratio of water to sediment within the slurry mixture is controlled to maximize efficiency. The main types of hydraulic dredges are pipeline and hopper dredges.

Pipeline Dredges - Cutterhead Suction Dredge
Pipeline dredges are designed to handle a wide range of materials including clay, hardpan, silts, sands, gravel, and some types of rock formations without blasting. They are used for new work and maintenance in projects where suitable placement/disposal areas are available and operate in an almost continuous dredging cycle resulting in maximum production, economy, and efficiency. Limitations of pipeline dredges include relative lack of mobility, long mobilization and demobilization, inability to work in high wave action and currents, and are impractical in high traffic areas.

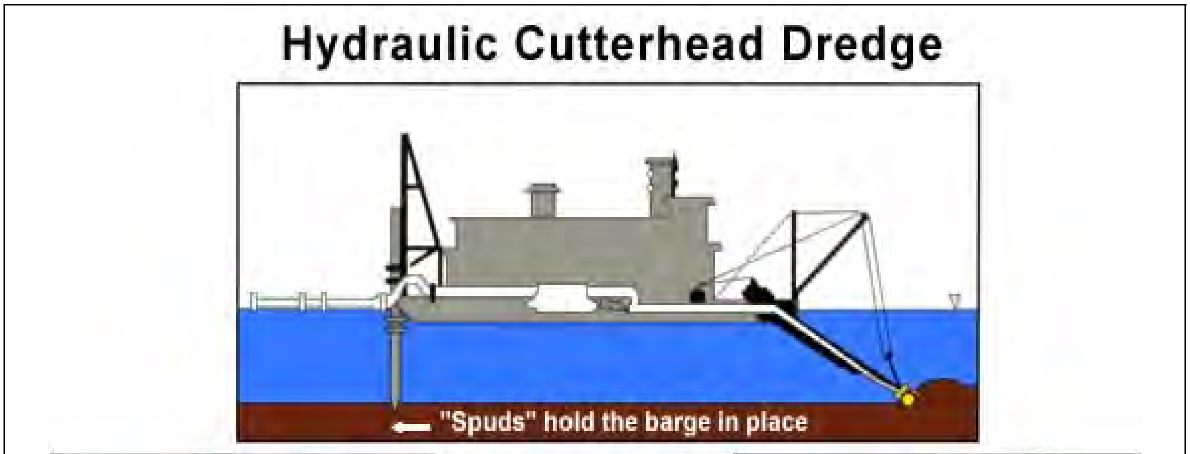
Pipeline dredges are rarely self-propelled and; therefore, must be transported to and from the dredge site. Pipeline dredge size is based on the inside diameter of the discharge pipe which commonly ranges from 6" to 48." They require an extensive array of support equipment including pipeline (floating, shore, and submerged), boats (crew, work, survey), barges, and pipe handling equipment. Most pipeline dredges have a cutterhead on the suction end. A cutterhead is a mechanical device that has rotating teeth to break up or loosen the bottom material so that it can be sucked through a pipe to the dredge (Figure 5).

Large cutter-suction dredges, or cutterhead dredges, are mounted on barges. The key parts of a cutter-suction dredge include:

- The cutter-suction head that resembles an egg beater with teeth that break up the dredged material as it rotates. The broken material is hydraulically moved into the suction pipe for transport.
- The cutter suction head is located at the end of a ladder structure that raises and lowers it to and from the bottom surface.
- The discharge pipeline connects the cutter suction dredge to the disposal location. The dredged material is hydraulically pumped from the bottom, through the dredge, and through the discharge pipeline to the disposal location. This is generally an upland site, but can be a scow for transport to a remote location, ODMDS or an in-water site.
- Dredge pumps are located on the barge with additional pump(s) often located on the ladder, especially for deep water dredging projects such as Port Everglades. Booster pumps can also be added along the discharge pipeline to move the material greater distances.

Depending upon their design, cutterhead dredges can be used to remove blasted or unblasted rock and unconsolidated material. During the dredging operation a cutterhead suction dredge is held in position by two spuds at the stern of the dredge, only one of which can be on the bottom while the dredge swings. There are two swing anchors some distance from either side of the dredge, which are connected by wire rope to the swing wenches. The dredge swings to port and starboard alternately, passing the cutter through the bottom material until the proper depth is achieved. The dredge advances by "walking" itself forward on the spuds. This is accomplished by swinging the dredge to the port, using the port spud and appropriate distance, then the starboard spud is dropped and the port spud is raised. The dredge is then swung an equal distance to the starboard and the port spud is dropped and the starboard spud is raised.

A large cutterhead dredge could be used for the entire Port Everglades deepening project. Some pretreatment may be required for portions of the rock prior to dredging. Disposal options include transport by barges to the ODMDS or use as mitigation site creation material. When the material will be taken to the ODMDS, the material maybe loaded into scows using a barge known as a Spider barge. This barge allows for one scow to be loaded and a second to begin loading immediately after the first is complete, ensuring more efficient dredging due to lessened down time waiting for scows to return from the ODMDS. A spider barge was used at Miami Harbor during the 2005-2006 in a similar dredging event (Figure 6).



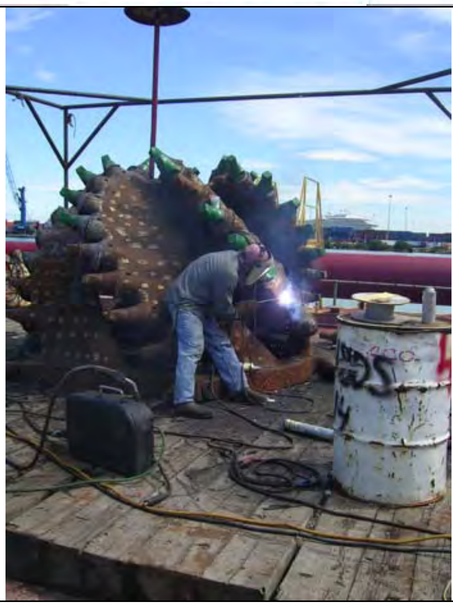


Figure 5 - Cutterhead pipeline dredge schematic and representative close-up photographs. (Video of cutterhead dredge: http://el.erdc.usace.army.mil/dots/doer/anima/cutterside.avi)

Figure 6 - A spider barge loading material into two scows from the cutterhead dredge, Texas, during Miami Harbor Phase II 2005-2006.

Hopper Dredge.

The hopper dredge, or trailing suction dredge, is a self-propelled ocean-going vessel with a section of the hull compartmented into one or more sediment containment chambers called hoppers. Fitted with powerful pumps, the dredges suck sediment from the channel bottom through long intake pipes, called drag arms, and store it in the hopper(s). Normal hopper dredge configuration has two dragarms, one on each side of the vessel. A dragarm is a pipe suspended over the side of the vessel with a suction opening called a draghead for contact with the bottom (Figure 7). Depending on the hopper dredge, a slurry of water and sediment is generated from the plowing of the draghead “teeth,” the use of high pressure water jets, and the suction velocity of the pumps. The dredged slurry is distributed within the vessels hopper allowing for solids to settle out and the water portion of the slurry to be discharged from the vessel during operations through its overflow system. When the hopper attains a full load, dredging stops, the dragarms are lifted off the bottom and the ship travels to an in-water disposal site, where the dredged material is discharged through the bottom of the ship by splitting the hull, or opening doors located in the bottom of each hopper. Some hopper dredges are capable of pumping the material back out of the vessel and through a series of shore-pipe to a designated placement/disposal location.

Hopper dredges are well suited to dredging heavy sands. They can maintain operations safely, effectively, and economically in relatively rough seas and because they are mobile, they can be used in high-traffic areas. They are often used at ocean entrances and offshore, but cannot be used in confined or shallow areas. Hopper dredges also have several limitations. Considering their normal operating conditions, hopper dredges cannot dredge continuously. The precision of hopper dredging is less than other types of dredges; therefore, they have difficulty dredging steep side banks and cannot effectively dredge around structures.

Figure 7 - Hopper dredge and dragarm being lowered into the water (Video of hopper dredge - http://el.erdc.usace.army.mil/dots/doer/anima/turtle.avi)

The Corps will incorporate the Terms and Conditions in NMFS' 1997 "Regional Biological Opinion (RBO) on Hopper Dredging along the South Atlantic Coast" into the project specifications, or any subsequent Regional Biological Opinion issued for hopper dredging. Although the SARBO does not include new harbor deepening projects in the project description, the Corps expects that that protective measures of the SARBO are sufficient to protect sea turtles in Port Everglades where the Corps has dredged on previous occasions with a hopper dredge without incidental take of sea turtles (2005 O&M dredging; 2004-2005 Broward Shore Protection project). The 1997 RBO incorporates (by reference) NMFS' 1995 Biological Opinion on hopper dredging of channels and beach nourishment activities in the southeastern US from North Carolina through Florida East Coast. The Corps' specifications will require their contractor(s) to follow the Terms and Conditions in the 1997 and 1995 Biological Opinions mentioned above, with the exception of the conditions related to the southeast United States' North Atlantic Right Whale calving area, because the proposed project is not located in or near the calving area. The Corps will also incorporate the protective measures of NMFS' March 23, 2006, Sea Turtle and Smalltooth Sawfish Construction Conditions into the project plans and specifications.

Mechanical Dredges

Mechanical dredges are characterized by the use of some form of bucket to excavate and raise the bottom material (Figure 8). They remove material by scooping it from the bottom and then placing it onto a waiting barge/scow or directly into a placement/disposal area. Mechanical dredges work best in consolidated, or hard-packed, materials and can be used to clear rocks and debris. Dredging buckets have difficulty retaining loose, fine materials, which can be washed from the bucket as it is raised. Special buckets have been designed for controlling the flow of water and material from buckets and are used when dredging contaminated sediments. Mechanical dredges are rugged and can work in tightly confined areas. They are mounted on a large barge and are towed to the dredging site and secured in place by anchors or spuds. They are often used in harbors, around docks and piers, and in relatively protected channels, but are not suited for areas of high traffic or rough seas.

Backhoe dredges and clamshell dredges, named for the scooping buckets they employ, are the two most common types. For clamshell dredges, a bucket dredge begins the digging operation by dropping the bucket in an open position from a point above the sediment. The bucket falls through the water and penetrates into the bottom material. The sides of the bucket are then closed and material is sheared from the bottom and contained in the bucket compartment. The bucket is raised above the water surface, swung to a point over the barge, and then released into the barge by opening the sides of the bucket. Usually two or more disposal barges, called dump scows, are used in conjunction with the mechanical dredge. While one barge is being filled, another is being towed to the disposal site by a tug and emptied. If an upland disposal area is used, the material must be unloaded using mechanical or hydraulic equipment. Using numerous barges, work can proceed continuously, only interrupted by changing scows or moving the dredge. This makes mechanical dredges particularly well suited for dredging projects where the disposal site is many miles away.

The backhoe dredge is essentially a power shovel mounted on a barge. The backhoe digs toward the machine with the bucket penetrating from the top of the cut face. The operation cycle is similar to the clamshell dredge, as are the factors affecting production. Backhoe marine excavators have accurate positioning ability and are able to excavate firm or consolidated materials. However, they are susceptible to swells and have low to moderate production. Backhoe marine excavators could be used to excavate unconsolidated overburden, fractured rock, and possibly some unfractured rock. It should be noted that one of the largest backhoe marine excavators in the U.S. was unsuccessful in dredging rock within Miami Harbor in the early 1990s in some locations without a pretreatment fracturing technology, and the rock at Port Everglades is expected to be harder based on geotechnical analysis.

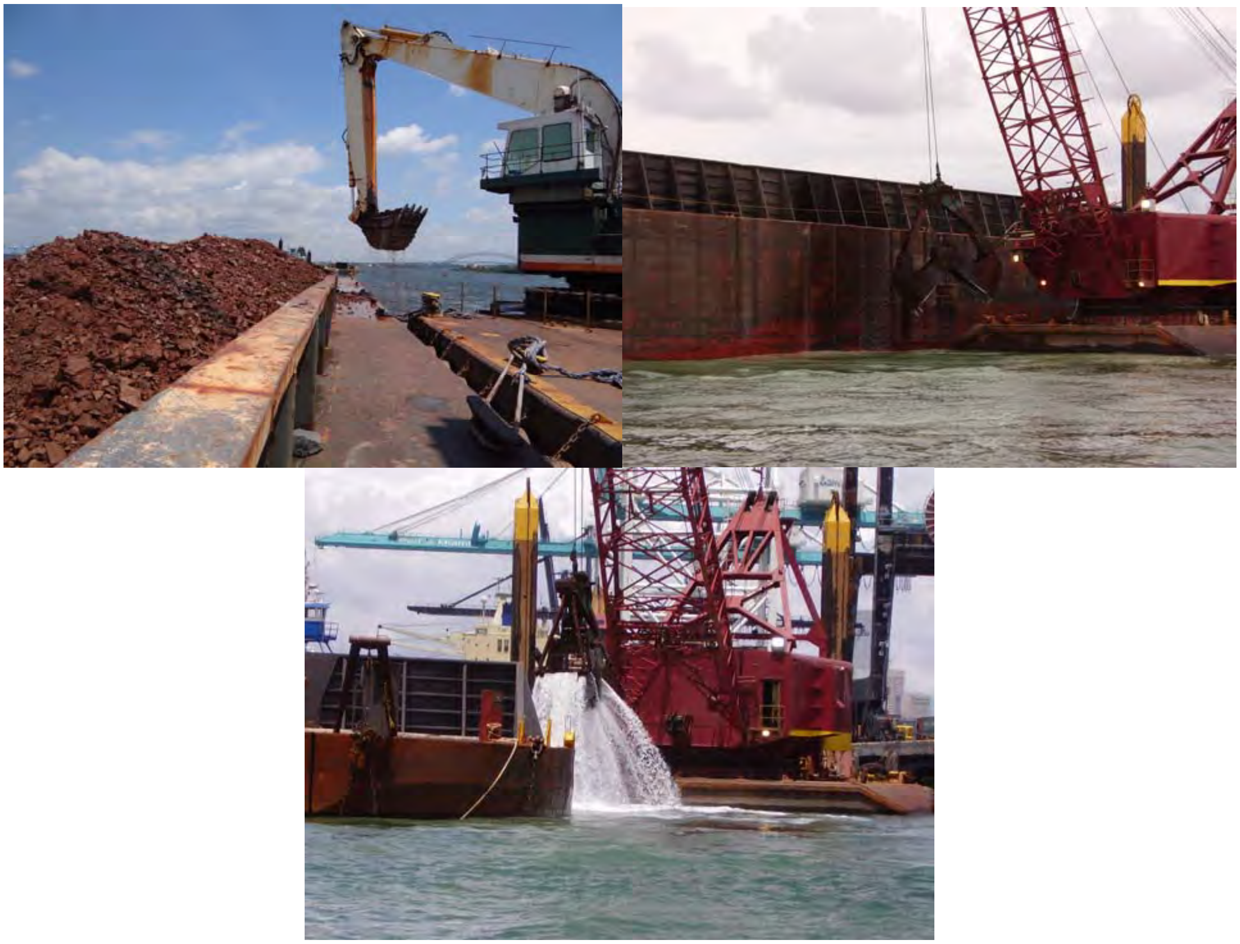


Figure 8 - Mechanical dredges (clamshell bucket/back-hoe dredge and barge). (Video of clamshell dredge - http://el.erdc.usace.army.mil/dots/doer/anima/clamshel.avi.)

Dredged Material Disposal

As previously stated, for the Port Everglades project, two disposal options are available. The first the disposal option is placement of dredged material in the EPA designated ODMDS located approximately four statute miles east of the entrance of the Port Everglades outer entrance channel in water depths ranging from 640-705 feet. Detailed information concerning this site is located on EPA's Ocean Dumping homepage located at http://www.epa.gov/region4/water/oceans/sites.html#portevergladesharbor and the Corps' Environmental documents website - http://www.saj.usace.army.mil/Divisions/Planning/Branches/Environmental/DocsNotices_OnLine_BrowardCo_PBPE.htm. The second disposal option is the potential creation of a potential artificial reef for mitigation with rock dredged from the project area. Any unconsolidated material in the channel (beach quality sand) that may have filled in the channel south of the south jetty, may be removed by a hopper dredge and placed in accordance with the Environmental Assessment for Operations and Maintenance Dredging completed with a Finding of No Significant Impact signed on April 28, 2005, that the Corps completed two ESA consultations for in 2004 and 2012, both resulting in concurrence with the Corps' determination that O&M dredging of Port Everglades was either already covered by the 1997 South Atlantic Regional Biological Opinion (NMFS, 2004) or a determination that placement of beach quality O&M material, "may affect, but is not likely to adversely affect" listed species under NMFs' purview. Additionally, NMFS concurred that the placement of beach quality O&M material was not likely to adversely modify designated critical habitat offshore of the dredged material placement area, John U Lloyd state park (NMFS, 2012).

Transportation Methodology – Hopper Dredges, Tugs/Scows, and Barges

Depending on the dredging and disposal site conditions, as a component of hydraulic and mechanical dredging operations, accompanying equipment such as tugs and barges (hopper, scow, spider barge, etc.) may be used in association with dredging activity in order to transport the dredged material to the pre-determined disposal sites. Methods of transporting dredged material to disposal sites include self propelled transport via hopper dredges or towing/pushing of loaded barges to disposal sites via tugboats. Tugboats are a component of all dredging operations and may be used to move immobile equipment into place as well as towing loaded barges to the disposal sites. Hopper dredges or bucket and barge operations are often used when disposal areas are beyond the pumping distance of pipeline dredges considering that hopper dredges and barges can transport material over long distances to the placement/disposal sites. Depending on a myriad of factors such as the type of dredged material, cubic yardage to be dredged, barge capacity, overflow capability, distance of the placement/disposal site, weather, etc., there may be types of dredges that consistently rotate from the dredge site to the placement/disposal site to achieve maximum efficiency and productivity. The number of hopper loads or barges towed, the transport interval, and the speed to the placement/disposal site will vary depending on these factors.

Hopper/scow locations are monitored at all times via the Dredging Quality Management (DQM) system and the contractor can be penalized for violating the specifications. The ullage (loaded draft) of each scow is recorded approximately every 30-seconds to determine if there is any loss of material from the scow during transit. This data is reviewed after each load by the contractor and the Corps/EPA and if the if a barge has a net loss of more than one foot in draft between the dredge site and disposal site(s) (averaged between the bow and stern monitoring locations), this serves as a "red flag" to conduct an investigation as to why the draft loss occurred. If the draft loss can be determined due to high seas and sloshing of material, no other action is required. However, if the loss is not as a result of high seas and sloshing, the barge is temporarily removed from the rotation and has the seals tested and repaired (if necessary). If a particular barge demonstrates a trend of material loss that does not resolve itself after seal testing and repair, the barge is removed from the dredging operation. One-foot of loss has been determined by Corps and EPA to be a good threshold for notification, because all barges have some amount of draft loss through leakage or water sloshing out of the barge due to sea conditions and weather, although the amount is typically minimal.

Hopper dredge and scows will be loaded with dredged material and taken to the ODMDS or approved artificial reef site. As part of the Corps' standard environmental protection specifications, the vessels are required to remain the marked channel until passing the outer buoy to prevent any accidental release of material from the scow/hopper that might settle on adjacent reef habitats.

> *"Due to the presence of hardbottom reefs adjacent to the channel, the Contractor shall stay within the marked entrance channel while in transit from the dredging area to the ODMDS, and on the return trip, until past the last channel marker."*

Hopper dredge and disposal tug/scow transit tracks will be recorded by the Contractor and reviewed within 24 hours of the transit to the disposal site to ensure the vessel remained in the marked channel or approved corridor to the mitigation site. If the dredge/tug & scow leaves the channel or approved corridor, the location will be marked and recorded in GIS, water depths of the location will be determined by reviewing existing surveys and, draft of the vessel will be determined by the DQM system. If it is determined that the potential exists for an impact to have occurred as a result of the vessel leaving the channel or approved corridor, a survey team will be deployed to assess any impact that may have occurred and conduct immediate remediation. Remediation work (including re-attachment of scleractinian corals and octocorals) will be conducted immediately after the survey by the survey crew. Remediation activities should follow the FLDEP-SEFCRI "Rapid Response and Restoration for Coral Reef Injuries in Southeast Florida, Guidelines and Recommendations" dated June 2007.

<u>Split Hull Barge</u>

A split hull barge (Figure 9) has two hulls connected with hinges at the front and back. The two-door hinged configuration, allows the hulls to swing apart, opening at the bottom to allow dredged material to fall from the barge. This provides a rapid disposal of dredged material, which, as a result, is placed within a small area. The rapid descent of material through the water column reduces the potential for resuspension of sediments into the water column during disposal. Such a barge may be used for ODMDS disposal. A rubber seal (similar to a gasket or weather-stripping on a door), is pinched between the two doors, limiting the leakage from the barge of water and dredged material. This seal does not prevent 100% of water and dredged material from leaking; however it minimizes it to the maximum extent practicable. During transport, the barge's draft and ullage are monitored and recorded and this data is reviewed after each load to detect loss of draft, which is assumed to represent loss of material. If a barge has a net loss of more than one foot in draft between the dredge site and disposal site(s) (averaged between the bow and stern monitoring locations), this serves as a "red flag" to conduct an investigation as to why the draft loss occurred. If the draft loss can be determined due to high seas and sloshing of material, no other action is required. However, if the loss is not as a result of high seas and sloshing, the barge is temporarily removed from the rotation and has the seals tested and repaired (if necessary). If a particular barge demonstrates a trend of material loss that does not resolve itself after seal testing and repair, the barge is removed from the dredging operation. One-foot of loss has been determined by Corps and EPA to be a good threshold for notification, because all barges have some amount of draft loss through leakage or water sloshing out of the barge due to sea conditions and weather, although the amount is typically minimal.

Figure 9 - Split-hull barge

__Bottom Dump Barge__

A bottom dump barge has doors on the bottom of the hopper, which opens at the disposal site to allow the dredged material to fall to the bottom. This type of barge has slower disposal than split hull dump barges and material spreads over a larger area. This barge may be used for ODMDS disposal. As with split hull barge, the bottom dump barge has seals around each of the doors to minimize leakage of material and water from the barge. The barge is monitored in the same method as the split hull barge and the same response is taken if the barge loses more than a net foot of draft. This type of barge may be used either for ODMDS disposal or construction of artificial reef sites.

__Flat Top Barge__

A flat top barge transports dredged material stacked on a barge deck and must be unloaded mechanically at the disposal site. As a result disposal time is slow but it is possible to drain dredged material with filters prior to disposal.

All three barge types are typically pushed or pulled to the disposal site by a tug (Figure 10) and for split hull and bottom dump barge, the disposal action is triggered remotely from the tug to the barge. The exact time the signal is given to the barge, and when the doors open and close are recorded in a tracking system for further data analysis and compliance tracking.

Figure 10 - Split Hull Barge Being Pushed by Tug

NMFS has previously consulted on disposal operations at the Port Everglades ODMDS under the EIS for designation of the ODMDS with EPA and determined "that adverse impacts were unlikely to occur to the shortnose sturgeon, smalltooth sawfish, or any of the whale and turtle species listed above as a result of project activities" (EPA 2005) and with the Corps (NMFS 2004).

Rock Pre-Treatment with Confined Blasting

The focus of the proposed blasting work at Port Everglades is to pre-treat bedrock prior to removal by a dredge utilizing confined blasting, meaning the shots would be "confined" in the rock. In confined blasting, each charge is placed in a hole drilled in the rock approximately 5-10 feet deep below the desired depth (see Figure 11) depending on how much rock needs to be broken and the intended project depth. The hole is then capped with an inert material, such as crushed rock (Figure 12; each bag as shown contains approximate volume of material used per discharge). This process is referred to as "stemming the hole." The blasting charge is set and then the chain of explosives within the rock is detonated.

For the Port of Miami Phase II expansion in 2005, which used confined blasting as a pre-treatment technique, the stemming material was angular crushed rock. The optimum size of stemming material is material that has an average diameter of approximately 0.05 times the diameter of the blast hole. Material must be angular to perform properly (Konya 2003). For the Corps project, project-specific specification will be prepared by the geotechnical branch of the District. In the Miami Harbor Phase II project, the following requirements were in the specifications regarding stemming material:

"*1.22.9.20 Stemming.* All blast holes shall be stemmed. The Blaster or Blasting Specialist shall determine the thickness of stemming using blasting industry conventional stemming calculation. The minimum stemming shall be 2 feet thick. Stemming shall be placed in the blast hole in a zone encompassed by competent rock. Measures shall be taken to prevent bridging of explosive materials and stemming within the hole. Stemming shall be clean, angular to subangular, hard stone chips without fines having an approximate diameter of 1/2-inch to 3/8-inch. A barrier shall be placed between the stemming and explosive product, if necessary, to prevent the stemming from settling into the explosive product. Anything contradicting the effectiveness of stemming shall not extend through the stemming."

It is expected that the specifications for any construction utilizing blasting at Port Everglades would have similar stemming requirements as those that were used for the Miami Harbor Phase II project. The length of stemming material will vary based on the length of the hole drilled, however minimum lengths will be included in the project specific specifications. Studies have shown that stemmed blasts have up to a 60-90% decrease in the strength of the pressure wave released, compared to open water blasts of the same charge weight (Nedwell and Thandavamoorthy, 1992; Hempen *et al*. 2005; Hempen *et al*. 2007). However, unlike <u>open-water, i.e., unconfined blasts</u> (Figure 13), very little peer-reviewed research exists on the effects that confined blasting can have on marine animals near the blast (Keevin *et al*. 1999). The visual evidence from a typical <u>confined blast</u> is shown in Figure 14.

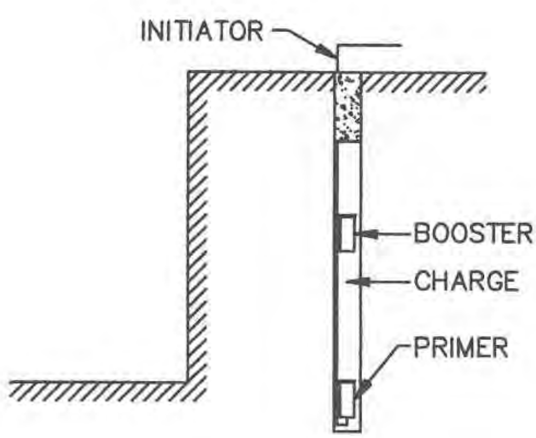


Figure 11 - Typical Stemmed Hole for Loading Charges

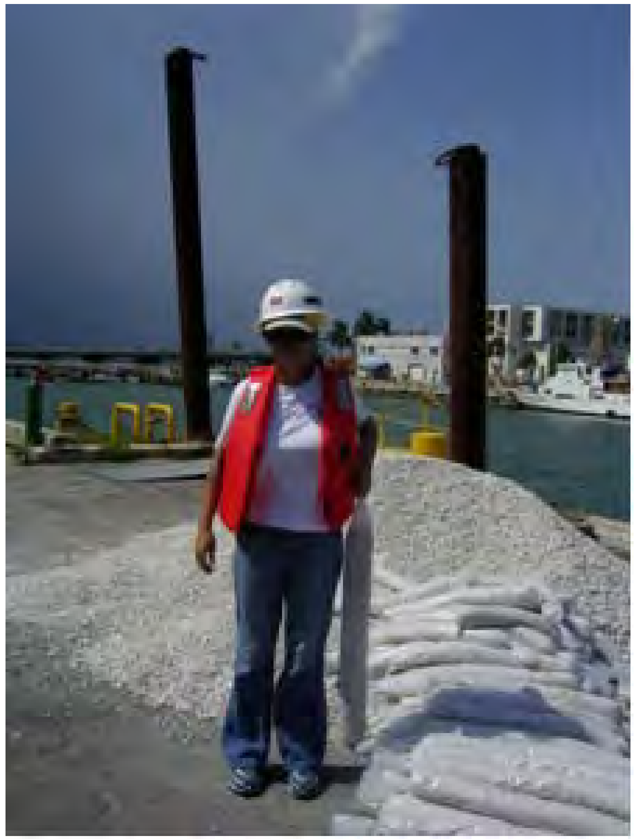


Figure 12 - Stemming Material and model for scale

Figure 13 - Unconfined Blast of Seven Pounds of Explosives

Figure 14 - Confined Blast of 3,000 Total Pounds of Explosives

To estimate the maximum poundage of explosives that may be utilized for this project, Corps has reviewed two previous blasting projects, one at San Juan Harbor, Puerto Rico in 1994 and one at Miami Harbor in 2005. The San Juan Harbor project's heaviest delay was 375 lbs per delay and in Miami it was 376 lbs per delay. Based on discussions with Corps's geotechnical engineers, it is expected that the maximum weight of delays for Port Everglades will be larger since the rock is much harder than what is seen at the Port of Miami. It is unknown at this time what the maximum delay weight will be for Port Everglades. This will be determined during the test blast program.

Minimization of Confined Blasting Impacts to Fish and Wildlife

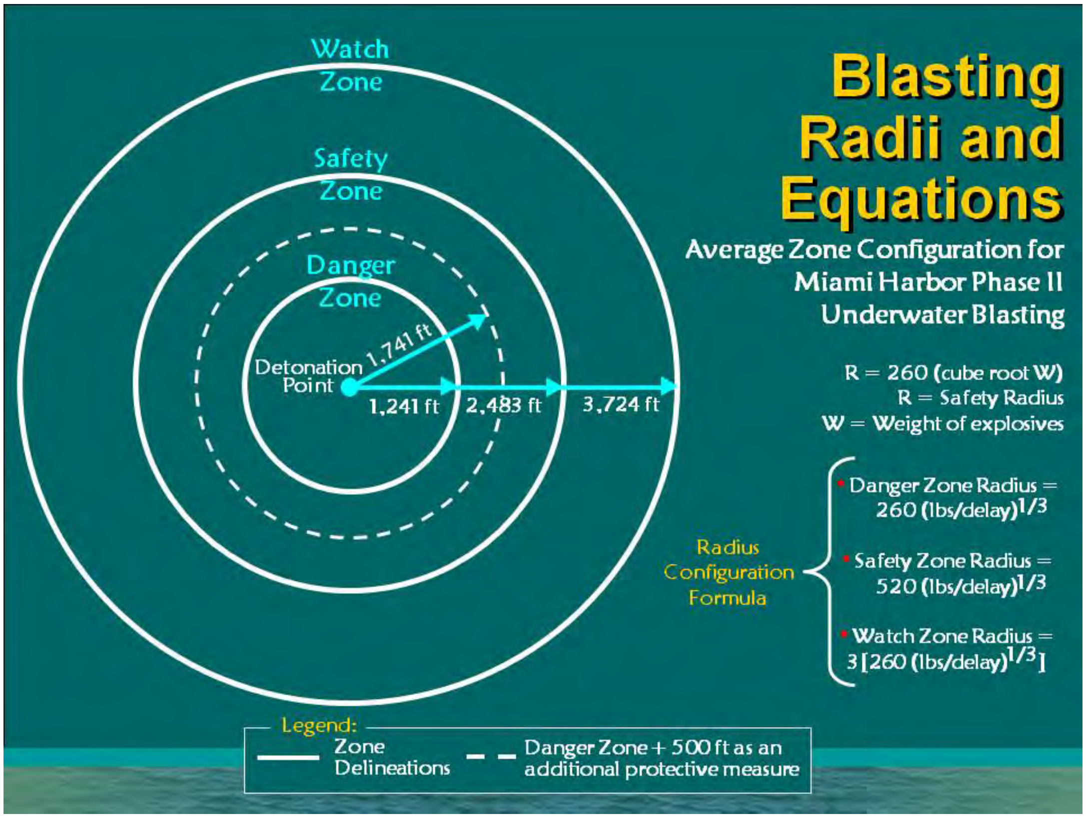
Blast specifications. Although the rock at Port Everglades is believed to be harder than Miami or San Juan Harbors, as noted above, Corps biologists, working with senior geologists, concluded that the assumptions set forth concerning minimization of the effects of blasting are applicable and accurate for the Port Everglades project. To that effect, based upon industry standards and Corps Safety & Health Regulations, the blasting program may consist of the following:

1) The weight of explosives to be used in each blast will be limited to the lowest poundage of explosives that can adequately break the rock.
2) Drill patterns are restricted to a minimum of 8-foot separation from a loaded hole.
3) Hours of blasting are restricted from two hours after sunrise to one hour before sunset to allow for adequate observation of the project area for protected species.

4) Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
5) Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.
6) The blast design will consider matching the energy in the "work effort" of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.
7) Delay timing adjustments to a minimum of 8 ms between delay detonations to stagger the blast pressures and prevent cumulative addition of pressures in the water.

Safety radii. Furthermore, the confined blasting program will incorporate the use of three safety radii (Figure 15) typically utilized for projects involving unconfined blasts. This conservative use of an *unconfined* blast in development of the safety radii for a *confined* blast will increase the protections afforded marine species in the area. These three zones are referred to as the "Danger zone" – which is the inner most zone, located closest to the blast; the "Safety zone" – which is the middle zone and the "Watch zone" the outer most zone.

The danger zone radius will be calculated to determine the maximum distance from the blast at which mortality to protected marine species is likely to occur. The danger zone was determined by the amount of explosives used within each delay (which can contain multiple boreholes). These calculations are based on impacts to terrestrial animals in water when exposed to a detonation suspended in the water column (unconfined blast) as researched by the U.S. Navy in the 1970s (Yelverton *et al*. 1973; Richmond *et al.* 1973) as well as observations of sea turtle injury and mortality associated with unconfined blasts for the cutting of oil rig structures in the Gulf of Mexico (Young 1991). The reduction of impact by confining the shots would more than compensate for the presumed higher sensitivity of marine species. Corps believes that the danger zone radius, coupled with a strong protected species observation and protection plan is a conservative, but prudent, approach to the protection of marine wildlife species. Based on a review by NMFS-OPR for the Miami Harbor phase II project, where these radii were first used, NMFS and FWS found these protective measures sufficient to protect marine mammals under their respective jurisdictions (NMFS 2005c; FWS 2002, NMFS 2011).



These zone calculations will be included as part of the specifications package that the contractors will bid on before the project is awarded. Ideally the safety radius should be large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed.

Radii specifications are as follows:

1) Danger Zone: The radius in feet from the detonation beyond which no expected mortality or injury from an open water explosion is likely to occur (NMFS 2005). The danger zone (ft) = 260 [79.25 m] X the cube root of weight of explosives in lbs per delay (equivalent weight of TNT).

2) The Safety Zone is the approximate distance in feet beyond which injury (Level A harassment as defined in the MMPA) is unlikely to occur from an open water explosion (NMFS 2005). The safety zone (ft) = 520 [158.50 m] X cube root of weight of explosives in lbs per delay (equivalent weight of TNT).

3) The Watch Zone is three times the radius of the Danger Zone to ensure that animals entering or traveling close to the Exclusion Zone are spotted and appropriate actions can be implemented before or as they enter any impact areas (i.e., a delay in blasting activities).

4) Exclusion Zone extends to 500 feet outside the Danger Zone radius. Detonation will not occur if a marine mammal or reptile may be within that zone (based on observational data).

It is crucial to balance the demands of the blasting operations with the overall safety of protected species in the project area. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide adequate observer coverage for whatever radius is agreed upon.

Monitoring/watch plan.
A watch plan will be formulated based on the required monitoring radii and optimal observation locations. The watch plan will be consistent with the program that was utilized successfully at Miami Harbor in 2005 and will consist of at least five observers including at least one (1) aerial observer, two (2) boat-based observers, and two (2) observers stationed on the drill barge (Figures 16, 17, 18 & 19). The 6th observer will be placed in the most optimal observation location (boat, barge, fixed structure or aircraft) on a day-by-day basis depending on the location of the blast and the placement of dredging equipment, as determined by the blaster in charge and the chief protected species observer. This process will insure complete coverage of the three zones as well as any critical areas. The watch will begin at least one-hour prior to each blast and continue for one-half hour after each blast (Jordan *et al*. 2007).

A blast-day (or blast-event) is made up of all the actions during a blast from the Notice to Project Team and Local Authorities two hours before the blast is detonated through the end of the protected species watch 30 minutes after the blast detonation. The typical events in a blast-event are:

<u>Typical Blast Timeline</u>

- T minus 2 HOURS - Notice to Project Team and Local Authorities
- T minus 1 HOUR - Protected Species Watch Begins
- T minutes 15 MINUTES - Notice to Mariners (channel closes)
- T minus 1 MINUTE - Fish Scare
- Blast detonation
- T plus 5 MINUTES - All Clear Signal
- T plus 30 MINUTES - Protected Species Watch Ends
- DELAY CAPSULE (can occur between T - 1 hour and detonation): If an animal is observed in either the danger or safety zones, the blast is delayed to monitor the animal until it leaves, on its own, from both the danger and safety zones

This timeframe lasts a minimum of 2 hours and 35 minutes, although it can be extended if a protected species (like a dolphin or turtle) enters the exclusion zone. The animal is monitored until it leaves, on its own, from both the danger and exclusion zones. There can be more than one blast-day (blast event) in a calendar day, although two is typically the maximum.

Data provided by Broward County Aviation Department on June 22, 2004 indicated that there do not appear to be flight path/altitude conflicts with a helicopter hovering 300-400 feet from the water surface in the MTB/upper SAC. Specific flight and observing plans will be coordinated with the FAA and Broward County Aviation Department to determine if aerial overflights are authorized throughout the entire project area due to the Port's proximity to Fort Lauderdale/Hollywood International Airport (FLL). If any conflicts develop due to the proximity of FLL to the Port that would prevent overflights of specific areas of the project that have been determined to require blasting, alternative monitoring methodologies will be investigated and coordinated with the resource agencies with jurisdiction for those issues. During the blasting conducted at Port Everglades in 1981, boat-based manatee surveys were conducted using a color fish-finder and located two additional manatees that were not located by aerial observers.

Figure 16 - Typical observer helicopter


Figure 17 - View of typical altitude of aerial observer operations


Figure 18 - Typical vessel for boat-based observer


Figure 19 - Observer on Drill Barge

Fish repulsion.
In the past, to reduce the potential for fish to be injured or killed by the blasting, Corps has allowed, and the resource agencies have requested, that blasting contractors utilize a small, unconfined explosive charge, usually a 1-lb booster, detonated about 30 seconds before the main blast to drive fish away from a blasting zone. It is assumed that noise or pressure generated by the small charge will drive fish from the immediate area, thereby reducing impacts from the larger and potentially more-damaging blast. Blasting companies use this method as a "good faith effort" to reduce potential impacts to aquatic resources. The explosives industry recommends firing a "warning shot" to frighten fish out of the area before seismic exploration work is begun (Anonymous 1978 in Keevin *et al*. 1997).

There is limited data available on the effectiveness of fish scare charges at actually reducing the magnitude of fish kills and the effectiveness may be based on the fish's life history. Some states require the use of fish scares (Illinois, New Jersey and Washington) while others (Alaska and Texas) have determined that they are ineffective and "potentially harmful to piscivorous fishes, marine mammals and birds which are attracted to feed on fish that are stunned or wounded by the repelling charge." Florida does not have a regulation specific to the use of scare charges associated with blasting (Lisa Gregg, pers. Comm., August 5, 2011), but FWC has requested the use of scare charges associated with previous projects that utilized blasting like the 2005 blasting at Miami Harbor. Numerous incidental observations (cited in Keevin *et al.* 1997) during blasting operation suggest that these charges are not effective in scaring fish from the blasting zone.

Keevin *et al.* (1997) conducted a study to test if fish scare charges are effective in moving fishes away from blast zones. They used three freshwater species, largemouth bass; channel catfish and flathead catfish, equipping each fish with an internal radio tag to allow the fishes movements before and after the scare charge to be tracked. Fish movement was compared with a predicted LD 0% mortality distance for an open water shot (no confinement) for a variety of charge weights. Largemouth bass showed little response to repelling charges and none would have moved from the kill zone calculated for any explosive size. Only one of the flathead catfish and two of the channel catfish would have move to a safe distance for any blast. This means that only 11% of the fish used in the study would have survived the blasts.

These results call into question the true effectiveness of this minimization methodology; however, some argue that based on the monetary value of fish (American Fishery Society 1992 in Keevin *et al.* 1997) including high value commercial or recreational species like snook and tarpon found in southeast Florida inlets like Port Everglades, the low cost associated with repelling charge use would be offset if only a few fish were moved from the kill zone (Keevin *et al*. 1997).

Vibration and Pressure Monitoring

Vibration.

In an urban environment such as the Port, which is surrounded by commercial properties, utilities, and residential communities, protection of structures must be considered. Once the areas of the project requiring blasting have been identified, critical structures within the blast zones would be determined. Where vibration damage may occur, energy ratios and peak particle velocities shall be limited in accordance with state or county requirements, whichever is more stringent. Furthermore, vibration-monitoring devices will be installed to ensure that established vibration limits are not exceeded. If the energy ratio or peak particle velocity limits are exceeded, blasting will be stopped until the probable cause has been determined and corrective measures taken. Critical monitoring locations may include structures such as bulkheads, hazardous materials storage areas, and buried utilities.

Ground-borne vibration can be generated by a number of sources, including road and railways, construction activities such as piling, blasting and tunneling. Vibration can be defined as regularly repeated movement of a physical object about a fixed point. The parameter normally used to assess the ground vibration is the peak particle velocity (PPV) expressed in millimeters per second (mm/s). In order to completely define ground vibration, the amplitude and frequency of the motion are measured in the three orthogonal directions generally in terms of velocity which is considered to be the best descriptor for assessing human comfort and the potential damage response of structures. The vibration velocity signals are summed (in real time) and the maximum amplitude of this vector sum is defined as the Peak Vector Sum (PVS). Vibration can cause varying degrees of damage in buildings and affect vibration-sensitive machinery or equipment. Its effect on people may be to cause disturbance or annoyance or, at higher levels, to affect a person's ability to work.

Corps reviewed data from the two most recent blasting projects completed by the district: the deepening of San Juan Harbor in 2000 and of Miami Harbor in 2005. Both used confined underwater blasting. Both projects had significant structural resources located near the blast that were of concern (the San Juan site included the National Park Service's Castillo San Felipe del Morro, a 400+ year old fortress overlooking the harbor and 30 additional historic sites within boundaries of the National Monument). In Miami, the harbor is bounded on the north by the port facilities and on the south by Fisher Island, a residential island. In both cases, a network of monitoring locations was established by the blasting contractor to capture vibration associated with the detonation of each blast. Additionally, at El Morro, the contractor installed monitoring devices on each crack in the stucco that covers the structure's interior walls, and a photo was taken after installation to serve as a pre-construction baseline. During construction, the crack was monitored throughout the blasting project to ensure that crack's width or length had not increased (Figure 20).

At Miami the maximum PVS allowed for the project was 1.0 mm/s. The average maximum PVS for the Miami Harbor deepening in 2005 was 0.3828mm/s with a range of 0.0819mm/s - 1.08mm/s during the 40 blast detonations. During both projects, no adverse impacts were reported to any of the surrounding structures by either the vibration monitoring contractor, or the building's owners/trustees.

Air Pressure.
The Corps Safety and Health Requirements Manual (EM 385-1-1 3, September 1996) limits of "air blast pressure exerted on structures resulting from blasting shall not exceed 133 dB (0.013 psi)" and industry standard vibration limitations would be incorporated into the design process. A conservative regression analysis of similar projects may be used to develop the design and then continually updated with calibration of the environment. The contractor will also be required to abide by state and local blasting requirements in addition to the Corps Safety Manual previously referenced in this paragraph.

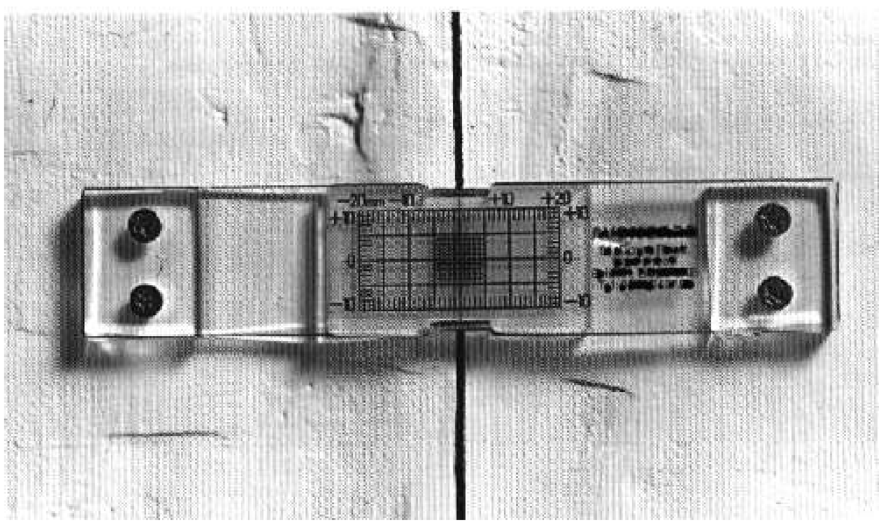


Figure 20 - Typical Crack Monitor Device

<u>Duration of Confined Blasting During Construction</u>
The duration of the blasting (pre-treatment) is dependent upon a number of factors including hardness of rock, how close the drill holes are placed, and the type of equipment that will be used to remove the pretreated rock. For comparison, the harbor deepening project at Miami Harbor in 2005-2006 estimated between 200-250 days of blasting with one-shot per day (a blast-day) to pre-treat the rock associated with that project. However, the contractor completed the project in 38 days with 40 blasts. The upcoming expansion at Miami Harbor scheduled to begin in spring of 2013 currently estimates 600 blast-days for the entire project footprint. However, the actual number of blast days may be reduced by the selected contractor, based on the previously mentioned factors. Using both Miami projects as a guide, and recognizing that 50% of the project footprint has been identified as possibly needing pre-treatment based on current information, Corps estimates approximately 900 blast-days for the Port

Everglades project, out of the total five years of uninterrupted construction, approximately 1,825 calendar days. This estimate is subject to change based on more detailed geotechnical analysis during the preconstruction, engineering and design (PE&D) phase of the project.

Adaptive Improvement of Blasting Specifications and Methods

Test Blast Program.

Prior to implementing a construction blasting program a test blast program will be completed. The test blast program will have all the same protection measures in place for protected species monitoring and protection as blasting for construction purposes. The purpose of the test blast program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted
- Directional Vibration
- Calibration of the Environment

The test blast program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. The test blast program will take place in the project area and will count toward the pre-treatment of material, since the blasts of the test blast program will be cracking rock. Each test blast is designed to establish limits of vibration and air blast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the test blast program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for construction blasting plan. During the testing the following data will be used to develop a regression analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

Fish Kill Monitoring.
In addition to monitoring for protected marine mammals, sawfish and reptiles in the area during blasting operations, Corps will work with the resource agencies to develop a monitoring plan for fish kills associated with each blasting event. This effort may be similar to the effort that was developed by FWC in association with the Port of Miami Phase II project, and is currently a requirement of the Miami Deepening project scheduled to start in the spring of 2013. This plan will be developed in detail during the PE&D portion of the project, but may include collection, enumeration and identification of dead and injured fish floating on the surface after each blast. In addition, blast data will be collected from the daily blasting reports provided after each shot by the blasting contractor, in addition to environmental data such as tidal currents (in-coming or out-going). Due to health and safety restrictions, all collections will be made from the surface only. No diving to recover fish carcasses is authorized.

Coordination.
As part of the development of the protected species protection and observation protocols, which will be incorporated into the plans and specifications for the project, Corps will continue to coordinate with the resource agencies (specifically BCEPD, NMFS, FWC, FWS and EPA) and NGOs to address concerns and potential impacts associated with the use of blasting as a construction technique.

Study Data.
In addition to coordination with the agencies and NGOs, findings from any new scientific studies regarding the effects of blasting (confined or unconfined) on species that may be in the area (marine mammals, sea turtles, fishes (both with a swim bladder and without) and reptiles will be incorporated into the design of the protection measures that will be employed in association with confined blasting activities in the port. Examples of these studies may include:

- "Caged Fish Study". As part of the August 1 & 2, 2006 After Action Review conducted for the Miami Harbor Phase II dredging project, which included blasting as a construction technique, Corps, in partnership with FWC, committed to conduct a study on the effects of blast pressures on finfishes with air bladders in close proximity to the blast. This study would attempt to answer the questions regarding proximity to the blast array, injury and death associated with confined blasting not resolved with research conducted with the Wilmington Harbor blasting conducted in 1999 (Moser 1998 and Moser 1999). This study is expected to be completed as part of the Miami Harbor 2013-2015 dredging project.
- Other blasting project monitoring reports for projects, both from inside and outside of Florida using confined underwater blasting as a construction technique completed prior to development of plans and specifications.

Conclusion.

Corps has concluded that confined blasting is the *least* environmentally impactful method for pre-treatment of hard, consolidated rock in the Port. Each blast will last no longer than 15 seconds in duration, and may even be as short as two seconds. Additionally, the blasts are confined in the rock substrate with stemming. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced significantly as compared to an unconfined blast (Nedwell and Thandavamoorthy 1992; Hempen *et al*. 2005; Hempen *et al*. 2007).

Protected Species Under NMFS Jurisdiction Included in this Assessment

The following endangered (E) and threatened (T) species under the jurisdiction of NMFS may occur in or near the action area:

Common Name	Scientific Name	Status
Marine Mammals		
Blue whale	*Balaenoptera musculus*	E
Fin whale	*Balaenoptera physalus*	E
Sei whale	*Balaenoptera borealis*	E
Humpback whale	*Megaptera novaeangliae*	E
Sperm whale	*Physeter macrocephalus*	E
North Atlantic Right whale	*Eubalaena glacialis*	E
Sea Turtles		
Loggerhead sea turtle	*Caretta caretta*	E/T
Hawksbill sea turtle	*Eretmochelys imbricate*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Green sea turtle	*Chelonia mydas*	E/T
Fish		
Smalltooth sawfish	*Pristis pectinata*	E
Plants		
Johnson's seagrass	*Halophila johnsonii*	T
Invertebrates		
Elkhorn coral	*Acropora palmata*	T
Staghorn coral	*Acropora cervicornis*	T

Critical Habitat

ESA-designated critical habitat for elkhorn and staghorn coral occurs within the action area.

The Corps has reviewed the biological, status, threats and distribution information presented in this assessment and believes that the following species will be in or near the action area and thus may be affected by the proposed project: four sea turtle species; Johnson's seagrass and smalltooth sawfish.

Marine Mammals

The full analysis of the life history of each of the six marine mammals in the impact area is provided in detail in the September 2004 Biological Assessment found in Appendix 2. The status of the six species has not changed since that analysis was conducted and it is incorporated by reference. These six species of endangered marine mammals may be found seasonally in the waters offshore southeastern Florida.

NMFS has previously consulted on effects of a large scale navigation expansion project (Miami Harbor) approximately 20 miles south of the Port Everglades project area for all six large whale species in 2003 and 2011. The same construction methodologies are being proposed for Port Everglades that were consulted on for Miami Harbor, and the same populations of the six large whale species were evaluated. Specifically NMFS said:

> "Blue, fin, sei, and sperm whales are predominantly found seaward of the continental shelf. Northern right whales and humpback whales are coastal animals and have been sighted in the nearshore environment in the Atlantic along the southeastern United States from November through March on their migration south. Right whales are rarely sighted south of northeastern Florida. None of these whale species are expected to be found in the shallow waters inshore of the outer reef. NOAA Fisheries believes that these whales could be affected by the use of explosives offshore of the outer reef; however, the COE has modified the proposed action such that explosives are not expected to be used seaward of the outer reef. NOAA Fisheries believes that this change in the proposed action, in combination with the above mentioned mitigation measures decreases the effects of the proposed action on listed whales to insignificant levels. If the COE decides to use explosives seaward of the outer reef they must reinitiate consultation as NOAA Fisheries believes that this may affect listed whale species." (NMFS, 2003a)
>
> "North Atlantic Right Whales and Humpback Whales
>
> North Atlantic right whales and humpback whales may be found in or near the action area. NMFS has analyzed the routes of potential effects on North Atlantic right whales and humpback whales from the proposed action and, based on our analysis, determined that potential effects are limited to the following: injury from potential interactions with construction (i.e., dredging) equipment (e.g., a dredge vessel striking a whale), injury from use of explosives, and temporary avoidance of the area during construction operations. The proposed project is not located in or near right whale calving areas. The COE will require the contractor to follow the safety conditions for blasting (noted in Section 3.1 above), therefore, NMFS concludes that the project's construction effects are discountable. In addition, the contractors will be required to abide by the NMFS' Vessel Strike Avoidance and Reporting guidelines. With implementation of these conservation measures, NMFS believes that the likelihood of right whales and humpback whales being adversely affected by the proposed action is discountable.
>
> Blue, Fin, Sei and Sperm Whales
>
> Blue, fin, sei, and sperm whales are predominantly found seaward of the continental shelf and are not expected to be found within the shallow waters inshore of the outer reef. Effects to whales include the risk of injury from construction, which will be discountable due to the species' mobility. Blue, fin, sei and sperm whales may be affected by being temporarily unable to use the site due to potential avoidance of construction activities and related noise, but these effects will be insignificant. Disturbance from construction activities and related noise will be intermittent

> and only occur during the day for part of the construction period and will not appreciably interfere with use of the area by listed species." (NMFS, 2011)

Sea Turtles

A summary of the life history and species status for each of the five species of sea turtles that may occur on the beaches of, or offshore of, Broward County are found in the Sept 2004 Biological Assessment and are incorporated by reference.

Broward County is within the normal nesting range of three species of sea turtles: the threatened loggerhead (*Caretta caretta*), the endangered green turtle (*Chelonia mydas*), and the endangered leatherback (*Dermochelys coriacea*). The endangered hawksbill sea turtle (*Eretmochelys imbricata)* has also been recorded nesting in the County on rare occurrences (Table 2). The majority of sea turtle nesting activity in Broward County occurs during the summer months of June, July and August, with nesting activity occurring as early as March and as late as September (Burney and Margolis 1999). The waters and habitats offshore of Broward County are also used for foraging and shelter for the three species listed above and possibly the hawksbill turtle and the Kemp's ridley turtle (*Lepidochelys kempii*) (USACE 2000). Due to the heavily developed nature of the Broward County coastline, the relative location of Highway A1A to the beach, and extensive beach front lighting, all of which have the potential to negatively impact nesting sea turtles and their hatchlings, Broward County has relocated all discovered nests at Pompano Beach, Deerfield Beach, Hollywood-Hallandale, and Fort Lauderdale since the inception of its sea turtle conservation program in 1978 (Burney and Margolis, 1998). In 2005, the State of Florida changed its policy regarding relocation of nests, and decreasing the number of nests relocated in Broward County to approximately 65-70% of the deposited nests countywide and then to about 28-30% of the nests in 2006 and 2007 (Lou Fisher, pers. com 2007). Sea turtle nests located within the boundaries of JUL are not typically moved unless their location is in jeopardy from storm surge, tidal inundation, or erosion (S. Leve and E. Cowan, pers com, 2011). If nests are relocated, they are typically moved south to a natural area with slightly higher elevation.

Table 2 Sea Turtle Nesting in Broward County: Number of Nests by Year and Species

Year	Green	Loggerhead	Leatherback	Hawksbill
2010	268	2,283	14	0
2009	71	1,808	45	0
2008	276	1,929	14	0
2007	233	1,593	41	0
2006	138	1,740	15	0
2005	208	1,819	25	2
2004	153	1,826	4	0
2003	78	2,335	12	0
2002	216	2,070	18	0
2001	26	2,321	39	0
2000	255	2,674	13	0
1999	24	2,584	12	0
1998	200	2,643	14	0
1997	29	2,216	42	0
1996	130	2,902	2	0
1995	52	2,567	15	0
1994	123	2,180	9	1

FWRI 2011 [Hawksbill data currently being confirmed for 2006-2010]

Between 1991-2009, 28 stranded sea turtles have been reported within or near Port boundaries: 16 loggerhead turtles, six green turtles, four hawksbill turtles, and two unidentified species. Of these 28, 13 were documented as incidental captures. one green turtle was caught on hook and line at John U Lloyd Beach State Park, and 12 (10 loggerheads, one green turtle, and one unknown) were caught in the FP&L power plant at Port Everglades (A. Foley, FWRI, pers com, July 29, 2011). Specific location information, i.e., latitude/longitude, for 2010 and 2011 have not yet been entered into the FWC database, so it is unknown if any strandings for those years were associated with the project area.

Fish - Smalltooth Sawfish

The smalltooth sawfish (*Pristis pectinata*) has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In U.S. waters, *P. pectinata* historically occurred from North Carolina south through the Gulf of Mexico, where it was sympatric with the largetooth sawfish *P. perotteti* (west and south of Port Arthur, TX) (Adams and Wilson, 1995). Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months. It also was an occasional visitor to waters as far north as New York.

Smalltooth sawfish, *P. pectinata,* were once common in Florida as detailed by the Final Smalltooth Sawfish Recovery Plan (NMFS 2009a) and are very rarely reported in southeast Florida. Their core range extends along the Everglades coast from the Ten Thousand Islands to Florida Bay, with moderate occurrence in the Florida Keys and at the mouth of the Caloosahatchee River. Outside of these areas, sawfish are rarely encountered and appear to be relatively rare (Simpfendorfer 2006). It does not appear to be a coincidence that the core range of smalltooth sawfish corresponds to the section of Florida with the smallest amount of coastal habitat modification. Corps requested sighting information from the FWC smalltooth sawfish sighting database on January 16, 2008 for the "area in and around Port Everglades, Broward County". In an email response dated January 16, 2008 FWC sawfish Biologist, Gregg Poulakis referred Corps to the FWC sawfish database previously provided to Corps in October 2007. A search of that database found a total of seven sightings of *P. pectinata* in Broward County between 1993 and 2007 ranging in size from 2.4-4.1 meters in length (FWC 2007). The locations of these sightings ranged from Pompano Beach through Lauderdale-By-the-Sea, including three sightings in the vicinity of the Port. In July 2011, Corps contacted FWC again, and was referred to NMFS-OPR, who has taken over management of the database. NMFS (via S. Norton, pers com) provided a figure of all of the smalltooth sawfish sightings throughout Broward County, which is shown below (Figure 21). NMFS provided data pertaining to a total of 15 individuals documented in Broward County between 2003-2011.

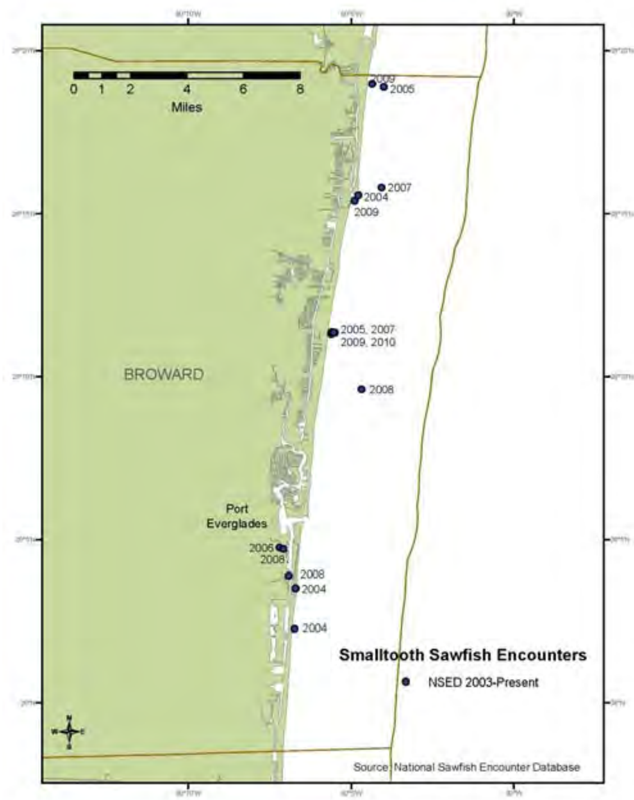


Figure 21 - Smalltooth sawfish observations, Broward County, Florida (2003-2011)

Possibly the most notable sighting of a *P. pectinata* in Broward County, in the vicinity of the Port took place at the Florida Power & Light (FP&L) Port Everglades power plant discharge canal on March 17, 2006 during an effort to capture an injured manatee in the canal (Figure 22). Based on data from FWC, the sawfish was approximately 10-12 feet

(120-144 inches) in length and was released from the manatee capture net without harm.

Figure 22 - Adult smalltooth sawfish incidentally captured in the FP&L power plant discharge canal

Habitat use by sawfish appears to be divided by animal size. Small sawfish (0-79 inches/0-200 cm) use shallow water areas as nursery areas often dominated by red mangrove habitats. The mangrove prop roots help serve as shelter against predation (NMFS 2009b and Simpfendorfer 2006). There is limited data available on habitat usage for large juvenile sawfish (>79 inches/201 cm). One tagged individual was recorded in water depths of less than 17 feet for 120-days (NMFS, 2006). Simpfendorfer found that a large percentage of animals greater than 300 cm (3 meters) in size were found in deeper water. Adult smalltooth sawfish use shallow coastal waters to deep shelf waters of up to 400 feet (NMFS 2009b). They may use navigation channels as a transit corridor between the shallow coastal and deeper water habitats. Mote Marine Laboratory (Simpfendorfer 2006) prepared a Habitat Suitability Index (HSI) for sawfish under contract to NOAA, for the entire state of Florida and found, that on a scale of 0-9 (with 9 being the best possible habitat for smalltooth sawfish), the water habitats in Broward county ranked between 2-3 on the HSI. This finding was based on the water depths adjacent to mangroves, distances to mangrove buffer and salinity. It should also be noted in that Broward County's tidal waterways are unique compared to other Florida coastal counties. Characterized as predominately linear, the marine waterways rarely exceed 1000 feet in width and most shorelines are stabilized with a seawall, rip-rap or other erosion control system (Broward County 2007). This determination by Simpfendorfer supports Corps's determination that the Port's existing habitats are not optimal for sawfish; the area is extremely limited for use by juveniles due to the lack of shallow water (less than one meter in depth) directly adjacent to large areas of mangroves. However, this does not mean that the areas near Port Everglades cannot support sawfish. This is also shown in the history of sawfish sightings in Broward County.

A review of the NOAA sawfish database provided one record of a sawfish smaller than two meters (168 cm), located offshore of Broward County near Pompano Beach, approximately 15 miles north of Port Everglades (Amanda Frick, NOAA, pers com, 25 July 2011). To date, no sawfish smaller than 2 meters (the size at which sawfish attain sexual maturity) has been documented within five miles of Port Everglades or within the boundaries of the Port.

NMFS released the final recovery plan for the smalltooth sawfish in January 2009 (NMFS, 2009), and designated critical habitat for the species in September 2009 (74 FR 45353).

Plants - Johnson's Seagrass

A detailed review of the biology and status of Johnson's seagrass is located in the September 2004 Biological Assessment and is incorporated by reference. *Halophila johnsonii* has the most limited geographic ranges of all seagrass species. It is known to occur only from 21.5 km north of Sebastian Inlet (i.e., near Palm Bay in Brevard County) south to northern Biscayne Bay (i.e., North Miami) on the east coast of Florida (Kenworthy 1997; Virnstein and Hall 2009). Although NMFS has listed *H. johnsonii* as a threatened species under Section 4 of the ESA, it has not promulgated a 4d rule under the Act, and as a result, there is no prohibition on take the *H. johnsonii*.

Seagrass habitat cover type, abundance, and density for the study area are described in the Environmental Baseline Surveys conducted in 1999, 2000, 2001, 2006 and 2009 (Figure 23). Additional surveys were carried out by Broward County in 2001 and 2004. The 1999 environmental baseline surveys for seagrasses occurred within the project area, which started approximately 1,200 feet north of the Port Inlet, then south along the IWW to approximately 1,000 feet south of the DCC juncture, and also along the DCC (DC&A 2001). In the 2000 survey, additional survey transects were located within the area 1,000 feet south of the DCC on the east side of the channel, and on the west side, from the DCC south to the Dania Beach Boulevard Bridge. Also, in order to field verify whether seagrass occurred in the OEC, as reported by the BCEPD staff (S. Higgins, Beach Erosion Administrator Broward County, pers com), an integrated video survey was performed within the OEC in 2001 (DC&A 2001). In 2006, thorough reconnaissance of the entire project area was completed, verifying that seagrasses were limited to the areas previously mapped in 1999 and 2000. After the reconnaissance effort, detailed seagrass surveys were conducted in the same project area as 1999 and 2000 field surveys (not including areas further south than approximately 1,000 feet south of the intersection of the DCC with the IWW (DC&A 2006)). In 2009, further thorough reconnaissance of the entire project area was completed, verifying that grasses remained in the previously mapped areas and had not established beds in new areas. After this reconnaissance effort, detailed seagrass surveys were conducted in the same project area as 2006 surveys (again, not including areas further south than approximately 1,000 feet south of the intersection of the DCC and the IWW) (DC&A 2009a; see Appendix D).

Several other seagrass surveys and anecdotal observations have occurred in the project area, including a Broward County seagrass survey in 2001, and a Broward County/FDEP QA/QC assessment for a previously conducted seagrass survey near the USN facility (the south side of the IEC) for a proposed Navy project in 2004. A permanent transect was established in April 2006 adjacent to the Coast Guard station to monitor annual changes in the documented *Halophila johnsonii* bed by Fish and Wildlife Research Institute (FWRI) (Jennifer Kunzelman, FWRI, pers comm, January 25, 2008). Also in 2008, seagrass surveys were conducted for Nova Southeastern University Oceanic Center's (NSUOC) boat basin and adjacent areas (Coastal Eco-Group 2008). Most recently in the summer of 2008, an interagency team conducted qualitative surveys within the project area. These studies have provided valuable supplemental information on seagrass populations changes and trends since 2001. In 2008 and 2009 Miller Legg conducted surveys for West Lake Park within the DCC portion of the project area. Due to the data collection methods, which may have included GPS point data in many cases, these data are not displayed in seagrass habitat maps, except for the 2009 dataset, which surveyed areas identified in the 2008 interagency survey effort.

Figure 23 - Transect coverage of all Corps seagrass surveys

Results from seagrass surveys conducted for the project (DC&A 1999; DC&A 2001; DC&A 2006; DC&A 2009) demonstrated that *H. johnsonii* occurs within the SAC (see Figures 24 and 25). *H. johnsonii was* documented by at least one survey in all assessment areas except OEC and IEC. In 2006, *H. johnsonii* was not observed in two assessment areas where it was previously observed, however it returned to these areas in 2009. The expansion and contraction of *H. johnsonii*, also referred to as "pulsating patches" may be a long-term survival strategy (Virnstein *et al*. 2009). The persistent presence of high-density elevated patches of *H. johnsonii* on flood tidal deltas near inlets suggests that it is capable of sediment stabilization (NMFS 2007).

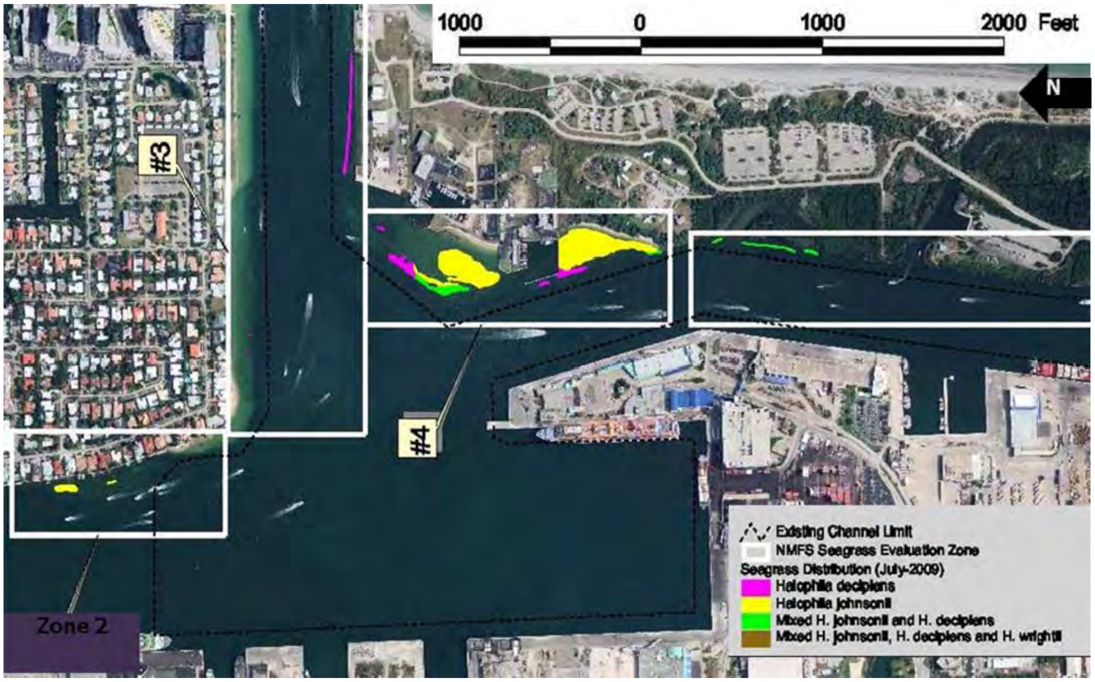


Figure 24 - Seagrass coverage in northern portion of project area

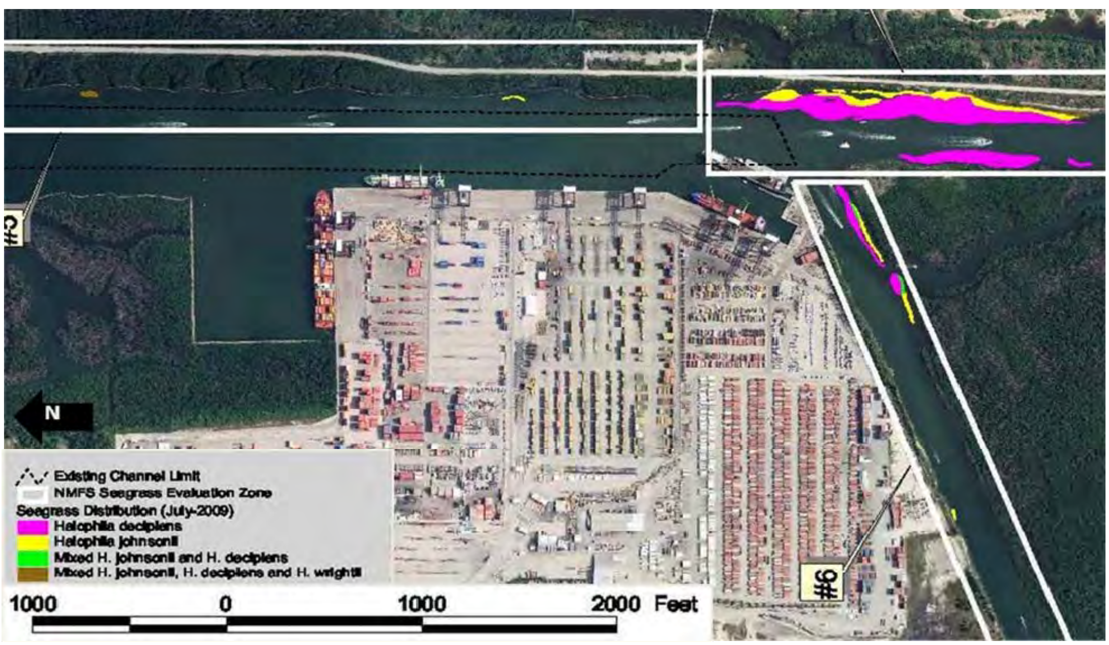


Figure 25 - Seagrass coverage in southern portion of project area

In Heidelbaugh (1999), *H. johnsonii* beds yielded a total of 126 species (69 epifauna and 57 infauna). Three hundred and twenty macrofaunal organisms were collected from *H. johnsonii* beds. NMFS has concluded that the conservation of *H. johnsonii* will not only maintain the diversity of the seagrass communities, but also the important biodiversity and biophysical characteristics of the entire ecosystem (NMFS 2007). Although *H. johnsonii* serves as hiding and resting area for many species, Gabiel and Hirons (2011), in a study specific to the project impact areas in the SAC, state "consumers in Port

Everglades are not feeding on seagrass” including some of the densest patches of *H. johnsonii* in the project area.

The total amount of *H. johnsonii* mapped in the project vicinity ranged between 1999-2009 from 4.81 acres to 5.40 acres with an average of 4.98 acres.

Table 3 - Mapped Johnson's seagrass in project vicinity

Bed Type (sp)	1999-2000 Acres	2006 Acres	2009 Acres	Average Acres coverage (minus DCC)
H. Johnsonii	2.85	2.80	4.68	3.44
Mixed *H. johnsonii/H. decipiens*	0.00	1.08	0.46	0.77
Mixed *H. johnsonii/H. decipiens/H. wrightii*	1.96	0.09	0.26	0.77
Totals	4.81	3.97	5.40	4.98

Critical Habitat

The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. These limits to the species' range have been designated as critical habitat for Johnson’s seagrass. Within its range, Johnson’s seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. There is no designated critical habitat within the action area (NMFS, 2000).

Invertebrates - Staghorn and Elkhorn Corals

Staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata*) corals were listed as threatened under the ESA on May 9, 2006, (71 FR 26852) based on a status review completed by NMFS in March 2005 (70 FR13151). NMFS published a “4D” rule for these *Acropora* species on October 29, 2008 (73 FR 64264) providing a list of activities that would result in “take” as defined by the ESA. NMFS published a final rule to designate critical habitat for these species on November 26, 2008 (73 FR 72210). NOAA has not yet prepared a recovery plan for either *Acropora* species. However a recovery plan development team completed a draft and provided this to NMFS for revisions and publication.

The Atlantic *Acropora* Status Review presents a summary of published literature and other currently available scientific information regarding the biology and status of both elkhorn and staghorn corals (http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/corals.pdf).

Based on the status review and final critical habitat designation, NMFS has determined that any hardground habitat located in Florida south of Boyton Inlet in Palm Beach County in waters less than 30 meters deep has the potential to support either of the *Acropora* species (NMFS 2005). The final critical habitat determination identifies that the primary constituent elements for the continued survival of acroporid species may be found in waters less than 30 meters in depth (NMFS 2007).

In October 2007, NMFS released the revised *Interim Acropora Survey Protocol for Section 7 Consultation*, a protocol for surveys to be conducted for projects within the known habitat of *Acropora* sp. Corps staff met with NMFS leadership in April 2008 to discuss the applicability of this interim protocol in high traffic federal navigation channels where human safety was a major concern. NMFS-OPR leadership agreed that a modified methodology for surveying for *Acropora* in 13 federal navigation channels within *Acropora* critical habitat was warranted. Working under this agreement, Corps developed a two-tiered survey approach. The two-tiered method includes integrated towed video survey, with a built in altimeter, that would allow the flyer and viewer to know the distance to the bottom, follow-up ground-truthing diver surveys, and diver surveys following the NMFS protocol.

Corps has conducted a total of four surveys (one specifically for Acropora in 2010) of the proposed project area between 2001-2010 (Figure 26), using a combination of towed video and divers, and has not documented the presence of either species in the project area.

Figure 26 – Total Survey Coverage by Corps for Port Everglades 1999-2011

Towed video transects covered more than 40% of the entire direct and indirect impact area. This is significantly more area than would be covered if the diver-only protocol would have been employed to survey for *Acropora spp.* in the project area. Twenty-one dives were made to identify organisms that were designated as "potential" *Acropora* colonies in post-processed video. No *Acropora* colonies were documented within the direct or indirect impact areas of the Port Everglades expansion area during this survey. Full results of this survey are found in the "Port Everglades Feasibility Study *Acropora* Coral Survey Final Report October 2010" (Appendix 6). Additionally, the US Navy conducted a survey of coral species located within the South Florida Ocean Measurement Facility Restricted OPAREA located immediately south of the OEC (USN 2011/Appendix 5) (Figure 27).

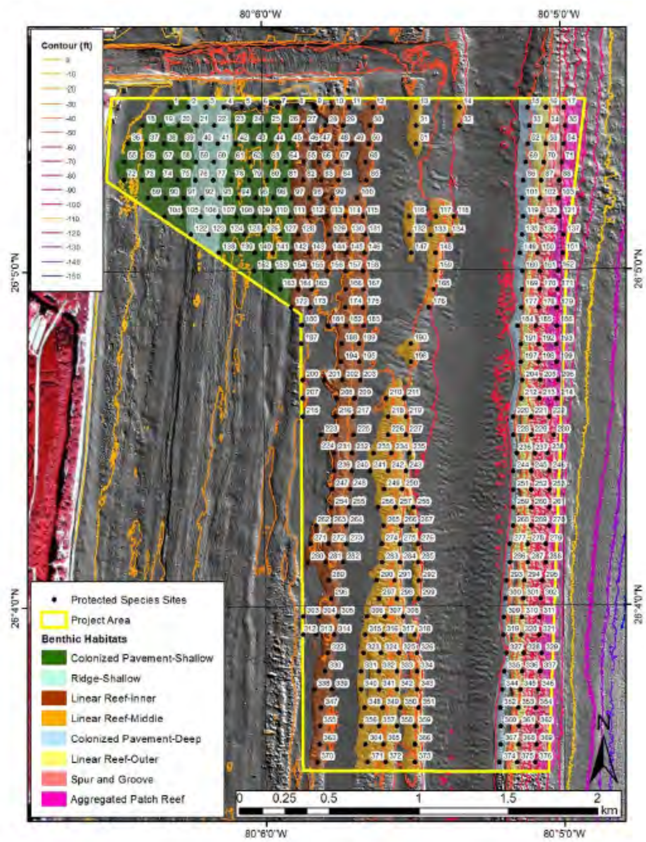


Figure 27 - US Navy Protected Coral Species Survey sample sites

A. cervicornis colonies are known to exist in the vicinity of Port Everglades, 2,780 feet (848m) to the south of the Port entrance channel, on the near shore hardbottom, and 1,400 feet (427m) north on the inner reef (Dial Cordy 2010, NOVA 2008). The Navy located *Acropora cervcornis* on the first, second and third reefs offshore of their facility located south of the OEC. *Acropora palmata* was not documented during the Navy survey. The closest documented *Acropora cerviconis* to the expansion project was located on the first reef, at the edge of the 150 meter (492 feet) buffer from the project footprint, approximately 500 feet south of the channel. This location is outside the indirect impact assessment area for the Port Everglades expansion project. Although the Navy survey did document *Acropora cervicornis* on the third reef, the closest documented colonies (1-5 colonies in density) were located more than a mile south of the 150-m project buffer (Figure 28). As of the writing of this document, no colonies of *A. palmata* have been documented within the vicinity of the existing channel. To-date, no *A. cervicornis* have been identified within the direct or indirect impact areas within the proposed Project area (Dial Cordy 2010, USN 2011).

Although *Acropora cervicornis* and *Acropora palmata* have not been located in the project footprint, or adjacent indirect impact zone, we recognize that this may change between the finalization of this consultation and initiation of construction dredging by the species migrating into the project footprint or that a colony less than 1-2 years old, not visible to the eye during the surveys (NMFS 2005) matures and becomes visible to the naked eye. As we have previously committed to in our letter dated October 18, 2006 and our October 13, 2006 Effects Determination Memorandum, if any *Acropora cervicornis* or *Acropora palmata* are located prior to or during project construction, the Corps will implement the protective measures detailed in the Terms and Conditions of the Miami Harbor September 2011 Biological Opinion (F/SER/2011/00029) reinitate consultation with NMFS under the ESA.

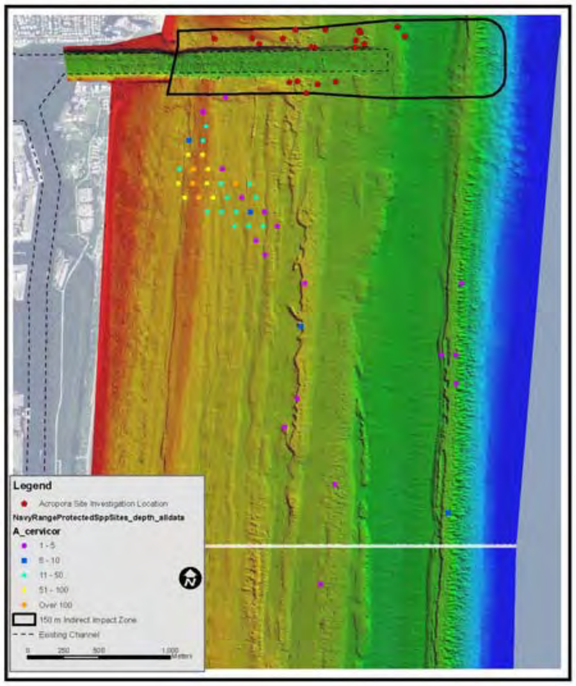


Figure 28 - Location of USN *A. cervicornis* colonies in comparison with Port Everglades Channel

<u>Critical Habitat</u>

On November 26, 2008, NMFS published a final rule in the Federal Register to designate critical habitat for Elkhorn and staghorn corals. Four specific areas were designated, including: the Florida unit (approximately 1,329 square miles of marine habitat); the Puerto Rico unit (approximately 1,383 square miles of marine habitat); the St. John/St. Thomas unit (approximately 121 square miles of marine habitat); and the St. Croix unit (approximately 126 square miles of marine habitat).

Designated critical habitat in the Florida Unit includes the Atlantic Ocean offshore of Broward County (Figure 29). Within these water depths, NMFS has defined that, ‘‘substrate of suitable quality and availability’’ is equivalent to consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover. (NMFS, 2008b). An area south of Port Everglades referred to as the “Dania RAA” was excluded from the DCH under 50 CFR §226.216(d). This area abuts the south side of the existing federal channel approximately 300 feet south of the channel, creating a 7.45 acre strip of DCH on the south side of the channel (Figure 30).

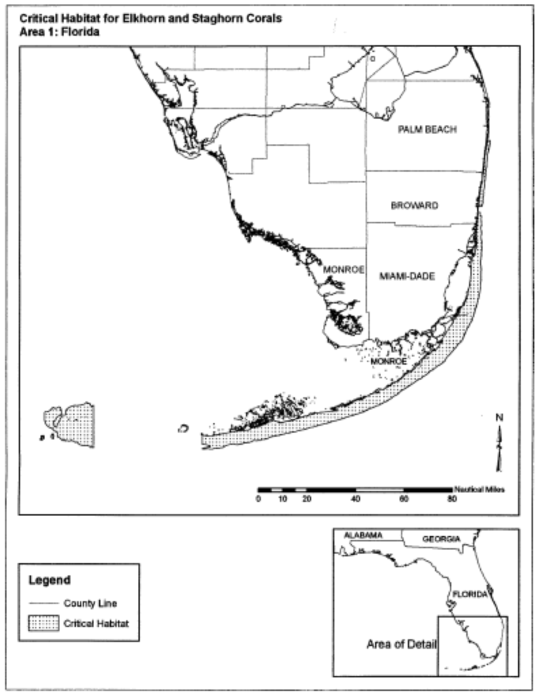


Figure 29 - Designated critical habitat for Elkhorn and staghorn corals in the Florida Area.

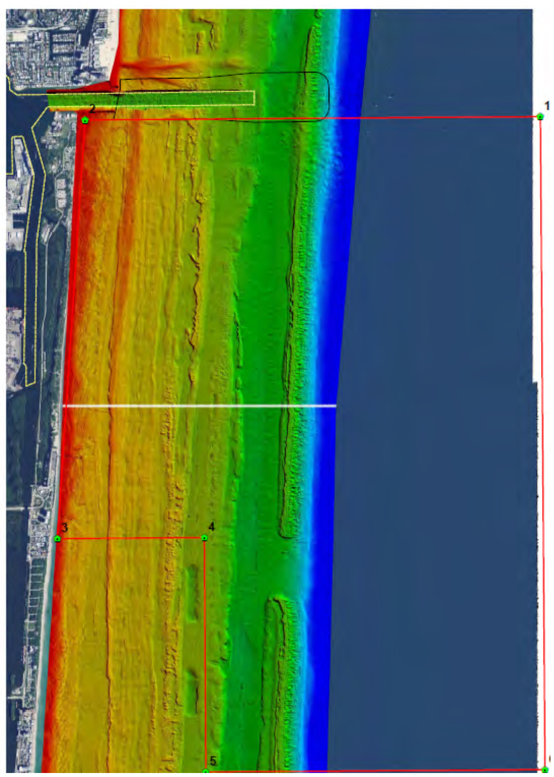


Figure 30 - Boundaries of Dania RAA in relation to Entrance Channel

Protective Measures to be taken in the Project Area as Part of the Proposed Action

Based on previous biological opinions issued by NMFS for adverse affects to listed *Acropora sp*., Johnson's seagrass, smalltooth sawfish and sea turtles associated with dredging and construction, the Corps plans to incorporate "terms and conditions" from these opinions into the plans and specifications for the Port Everglades project. These efforts will include:

1. Smalltooth Sawfish/Sea Turtles - Incorporation of the NMFS "Sea Turtle and Smalltooth Sawfish Construction Conditions" into the project plans and specifications:

a) The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b) The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c) Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d) All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e) If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f) Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g) Any special construction conditions, required of the project, outside these general conditions, if applicable, will be addressed in the primary consultation.

2. Acropora –
a) Transplantation of any Acroporid corals located during pre-construction surveys or during construction monitoring greater than 10 cm in size.
b) Turbidity monitoring during construction to meet the requirements in the Section 401 water quality certificate issued by the FLDEP.
c) Sedimentation monitoring during construction.
d) Maintaining a sufficient buffer from all mapped hardgrounds when placing rock for the reef mitigation creation site to ensure no damage occurs to those hardgrounds when placing the rock for artificial reef creation.

State of Florida

The State of Florida has numerous laws, regulations and programs aimed protecting corals and coral reef habitats, including those habitats that support Acroporid coral species. The Coral Reef Conservation Program (CRCP), as part of the Florida Department of Environmental Protection (FLDEP) coordinates research and monitoring, develops management strategies, and promotes partnerships to protect the coral reefs, hardbottom communities, and associated reef resources of southeast Florida. Through its role in supporting Florida's membership on the U.S. Coral Reef Task Force, and the U.S. All Islands Committee, the CRCP leads the implementation of the Southeast Florida Coral Reef Initiative and contributes to the National Action Plan to conserve coral reefs. The CRCP is also charged with coordinating response to vessel groundings and anchor damage incidents in southeast Florida, and developing strategies to prevent coral reef injuries. Florida Fish and Wildlife Conservation Commission's Wildlife Research Institute (FWRI) funds and conducts research activities on coral and hardbottom habitats throughout Florida, including those that support Acroporid corals and DCH.

Broward County

Broward County conducts numerous monitoring efforts throughout the county for all coral habitats, including Acroporid corals. They also deploy artificial reefs and maintain a mooring buoy program to establish a system of mooring buoys for recreational vessels to protect natural and artificial reefs from damage caused by boat anchors (http://www.broward.org/NATURALRESOURCES/BEACHANDMARINE/Pages/mooringbuoys.aspx). More than 120 buoys are available for use at various locations off Broward County. These sites include popular natural and artificial reef sites, including those habitats that may support Acroporid corals in Broward County. Broward County environmental staff also serves as the environmental assurance and compliance agent during county-sponsored in-water construction activities.

The Nature Conservancy

The Florida Reef Resilience Program brings scientists, reef managers and resource user groups together to develop strategies to improve the health of Florida's reefs and enhance the economic sustainability of reef-dependent commercial enterprises.

Scientific Research

NMFS provided an exception to the take prohibition for research and enhancement activities authorized by six (6) specific permit programs in the Acropora 4(d) Rule <http://sero.nmfs.noaa.gov/pr/pdf/AcroporaFinal4dRule.pdf> , they have not issued and permits under Section 10(a)(1) of the ESA to date (Jennifer Moore, pers.comm). Specifically for Broward County, any *Acropora* research would be permitted by the FWC. So long as a researcher holds a valid permit from FWC, no ESA sec 10 permit is required. NMFS may obtain a list of current permit holders from FWC as part of this consultation.

Other consultations of Federal actions in the action area to date

- None of the expansion projects authorized by Congress through 1968 were required to consult under the ESA. Port Everglades projects following implementation of the ESA are listed in the table below.

Date	Activity	Authorizing document/permit	Action	Volume of dredged material	Mitigation
1979-81	Port Expansion	H. Doc 93-144; 93rd Congress	Widening of entrance channel on a new alignment (shift centerline 75 ft north)	Not documented	Creating of Fishing Reef in SW Corning of "old" ODMDS in ~125 ft of water
1983	Berth 29 Bulkhead and Channel	USACE 81L-0624 FDER 060419139	Berth deepening and bulkhead construction	Dredge 311,000 cy material from unvegetated bottom	0.4 acres mangrove creation
1984	Pier 7 Channel Dredging	USACE 83D-2441 FDER 060257779	Channel deepening	Dredge 242,222 cy material from unvegetated bottom	None
1984	East Channel Dredging	USACE 84D-0385 FDER 060748269	Channel improvements	Dredge 46 acres unvegetated bottom, fill 4.73 acres of unvegetated bottom	None
1987	Construct Turning Notch	USACE 84R-4146 FDER 060924019	Port expansion	Removal of 18.27 acres of mangrove wetlands	Creation of 23 acres of mangroves, preservation of 48 acres of mangroves, creation of manatee refuge
1989	Construct Berth 33	USACE 84Y-4246 FDER 061407349	Port expansion	Removal of 2.0 acres of mangrove wetlands	Creation of 4.5 acres of mangroves
2004	Dredging of North Turning Basin		Operations and Maintenance Dredging	N/A	N/A
2005	Dredging of Entrance Channel		Operations and Maintenance Dredging – placement on JUL Beach as part of Broward SPP Seg III	Removed 40,523 cu yd of beach quality sand from inner entrance channel	N/A

2005-2006	Broward County Shore Protection Project, Segment 3	SAJ-1999-5545	Renourishment of Segment 3 of the Broward SPP from Beach fill extended from FDEP R-86 to R-92 within John U. Lloyd State Park, and R-99 to R-128 (Dade County line).	Burial of 7.6 acres of nearshore hardbottom (direct burial of 0.9 acres in John U. Lloyd State Park and 1.1 acres of worm rock habitat in Hollywood).	FDEP required the placement of 8.9 acres of mitigative artificial reef.

- The Corps and Broward County are currently in the planning process for a renourishment of Segment II of the Broward County Shore Protection Project located north of the port. ESA Consultation has not yet been initiated for that effort.
- Regulatory permits issued by the Jacksonville District's West Palm Beach Field Office under Section 10 of the Rivers and Harbors Act and/or Section 404 of the Clean Water Act are required to undergo consultation under Section 7 of the ESA. NMFS-PRD should have these consultations detailed in the PCTS tracking system for analysis.

Effects of the Action

Larger Vessels calling in the Future – All Species

Vessel Calls in a Without Project Condition

A major area of concern raised by resource managers is the increase in vessels expected to arrive as a result of the expansion of Port Everglades. The economic analysis of the project's without-project condition show as many as 8,984 vessels will be calling annually at Port Everglades, an increase from the pre-2009 baseline of more than 3,691 vessels (Table 4). This increase in vessel calls associated with the "Future without project" scenario/ No-Action Alternative will result in increased pressure on berth capacity as more ships arrive at the port and the port does not have more berthing capacity to absorb them. This will result in more ships waiting in the anchorage for berths to open and as a result may result in a greater likelihood of anchor damage or of a ship breaking free of the anchorage and grounding on the reefs shoreward of the anchorage. In a report about the usage of the Port Everglades Anchorage, Moffatt and Nichol (Moffat and Nichol 2006) documented that 50% of the grounding and anchorage damage was linked to vessels awaiting berths to open in Port Everglades. Although this report was specific to the old anchorage that was reconfigured to reduce impacts to the inshore reefs, as more vessels are crowded into the new anchorage, the potential for adverse impacts increases.

Table 4 - Baseline and Future Without Project Vessel Calls

	Baseline - Pre 2009			Future W/o Project 2009-2067				
Vessel Type	Baseline (High # Calls pre-2009)	Year	Passengers/tons	Future Calls w/o project	Projection Year	Passengers/tons	Change from base	Percentage change from base
Liquid bulk (minus Aframax)	467	2008		532	2066		65	12%
Aframax tanker	3	2008		3	2067		0	0%
Container								
PP2 = Post-Panamax 2 vessel size.	0	2008		103	2066		103	100%
PP1 = Post Panamax 1 vessel size.	23	2008		356	2066		333	94%
PEW= Panamax East West services.	117	2008		173	2066		56	32%
PNS = Panamax North South services.	190	2008		537	2066		347	65%
SP = Sub-Panamax size.	89	2008		187	2066		98	52%
Handy = Handysize.	491	2008		1388	2066		897	65%
Feedermax = Feedermax size.	235	2008		573	2066		338	59%
Feeder = Feeder size.	583	2008		1224	2066		641	52%
General Cargo	135	2006		176	2067		41	23%
RoRo	537	2006		1361	2067		824	61%
Cruise	2297	2004	4,075,406	2069	2067	6,879,729	-228	-11%
Dry Bulk	126	2006	2,954,310	302	2066	7,371,749	176	58%
	5293			8984			3691	

The Cruise industry has already launched two newer, larger classes of cruise ship since the economic and ship simulation analysis was completed by the Corps. When the Corps did the analysis for the project, the *Voyager of the Seas* (Voyager Class), launched in 1999, was the largest cruise ship in the world with a length of 1,020 ft, a beam (width) of 156 ft, a draft of 28 ft and a sail area (area above the water line) of 207 feet. In 2006, The *Freedom of the Seas* (Freedom Class) became the largest cruise ship in the world, with a length of 1,111 ft, a beam of 126 feet, a draft of 28 feet and a sail area of 209 feet. Currently, the *Oasis* and *Allure of Seas*, launched in December 2010 and October 2010, respectively, have a length of 1,187 feet, a beam of 154 feet, a draft of 31 feet and a sail area of 236 feet and are the largest cruise ships in the world. Both of these ships sail from Port Everglades.

Lastly, as larger ships call at Port Everglades, albeit light loaded and/or with higher sail area, they lack sufficient room in the outer entrance channel to respond to wind and varying current conditions in the channel, resulting in a higher risk of grounding on the reefs adjacent to the channel or scraping against the walls of the outer channel (allusion), impacting the resources that have colonized the walls since the channel was widened in 1980. This would also result in a higher likelihood of oil spills associated with vessels grounding (particularly petroleum vessels) and thus endanger human health and safety, in addition to the surrounding environment.

<u>Vessel Calls with Project Conditions</u>
Under the "with project" condition, the number of vessels calling at Port Everglades from all vessel classes is not expected to change significantly in association with the

additional depth. Growth projections showed increase use of the port with or without the deepening project, however, the amount of cargo and liquid bulk on the vessels is expected to increase as the vessels add more cargo in response to the additional water depth available for use, allowing for more efficient use of the vessels. The future without the project in 2067 estimates 8,984 vessel calls, an increase of 3,691 vessel calls into Port Everglades. With project vessel calls in 2067 are estimated to be 8,693, one call less than estimated without the project. Additionally, newer generations of cruise ships will add more passengers as the ships get larger. The project allows for a shift from smaller, less efficient ships, to larger, more efficient ships carrying more cargo without increasing the overall number of vessel calls, or possibly decreasing the number of vessel calls, which is consistent with national trends detailed in IWR 2012 and Figure 31. Table 5 provides a summary of historic and projected future vessel calls.

Table 1: Forecast East Coast Container Fleet 2012-2035

	2012	2015	2020	2025	2030	2035
0.1 - 1.3 k TEU	24	11				
1.3 - 2.9 k TEU	34	12	6	4	3	3
2.9 - 3.9 k TEU	28	12	10	4	4	2
3.9 - 5.2 k TEU	140	95	78	58	42	29
5.2 - 7.6 k TEU	86	114	153	156	159	168
7.6 - 12.0 k TEU	26	61	96	155	227	322
12.0 k TEU +		3	13	42	82	136

Note: post-Panamax vessel bands shaded in yellow. *Source: Maritime Strategies International, Limited*

This East Coast container fleet forecast shows the number of container vessels (by TEU range) being deployed on trade routes that include the U.S. East Coast ports. Vessels above 52k TEU are considered *post-Panamax* vessels.

Figure 31 - Shift from panamax to post-panamax ship class between 2012 and 2035 (IWR 2012)

Table 5 - Vessel Call Projects, Baseline, Future Without and Future With Project

With and Without Project Vessel Calls

		Baseline - Pre 2009			Future W/o Project 2009-2067					Future With Project 2009-2067					
Feasibility Study table	Vessel Type	Baseline (High # Calls pre-2009)	Year	Passengers/tons	Future Calls w/o project	Projection Year	Passengers/tons	Change from base	Percentage change from base	Future Calls w/ project	Projection Year	Passengers/tons	Change from base	Percentage change from base	Difference w vs wo project
4-33	Liquid bulk (minus Aframax)	467	2008		532	2066		65	12%	532	2066		65	12%	0
4-33	Aframax tanker	3	2008		3	2067		0	0%	2	2067		-1	-50%	-1
	Container														
7-1/8-11	PP2 = Post-Panamax 2 vessel size.	0	2008		103	2066		103	100%	103	2066		103	100%	0
7-1/8-9	PP1 = Post Panamax 1 vessel size.	23	2008		356	2066		333	94%	356	2066		333	94%	0
7-1/8-7	PEW= Panamax East West services.	117	2008		173	2066		56	32%	173	2066		56	32%	0
7-1	PNS = Panamax North South services.	190	2008		537	2066		347	65%	537	2066		347	65%	0
7-1	SP = Sub-Panamax size.	89	2008		187	2066		98	52%	187	2066		98	52%	0
7-1	Handy = Handysize.	491	2008		1388	2066		897	65%	1388	2066		897	65%	0
7-1	Feedermax = Feedermax size.	235	2008		573	2066		338	59%	573	2066		338	59%	0
7-1	Feeder = Feeder size.	583	2008		1224	2066		641	52%	1224	2066		641	52%	0
4-35	General Cargo	135	2006		176	2067		41	23%	176	2067		41	23%	0
4-36	RoRo	537	2006		1361	2067		824	61%	1361	2067		824	61%	0
4-37	Cruise	2297	2004	4,075,406	2069	2067	6,879,729	-228	-11%	2069	2067	6,879,729	-228	-11%	0
4-34	Dry Bulk	126	2006	2,954,310	302	2066	7,371,749	176	58%	302	2066	7,371,749	176	58%	0
		5293			8984			3691		8983			3690		

As a result of this analysis, there is no affect to any listed species under NMFS jurisdiction, associated with deepening of the harbor with regard to larger ship arrival as the number and sizes of ships arriving after project implementation is expected to remain the same, or possibly decrease, due to the ability for ships to be fully loaded in the “with project” condition. The extension and deepening of the outer entrance channel is expected to improve safety and navigability, reducing the potential for ship groundings and subsequent oil spills, both of which would result in adverse impacts to all species under NMFS jurisdiction in the action area.

Johnson’s Seagrass

Effects from Dredging.

Dredging would result in the permanent removal of up to approximately 3.57 acres of mixed or monoculture Johnson's seagrass where it occurs along the SAC and Widener based on the maximum coverage of Johnson’s seagrass seen in the 1999-2009 seagrass surveys. Average cover of *H. johnsonii* during this same period of time was 2.71 acres. The impact is considered permanent because deepening of shallow-water habitats beyond 10 to 13 feet (3 to 4 meters) is likely to impede post-dredging recolonization of areas that currently support *H. johnsonii* (NMFS 2007, Kenworthy 2000, and Hammerstrom *et al*. 2006). This effect would be seen throughout the improved Widener and SAC, where water depths will be at to 50 feet MLLW plus 1 foot of required overdepth and 1 foot of allowable overdepth for a total dredge depth of up to 52 ft MLLW. Due to implementation of water-quality-protection Best Management Practices (BMPs) and turbidity monitoring required under FDEP permit, Corps does not anticipate indirect effects to seagrasses including Johnson’s seagrass outside the impact footprint. Although seagrass habitat creation in Westlake Park as mitigation for unavoidable impacts, is being proposed, impacts to ESA species/resources cannot be mitigated, and there is no guarantee that *H. johnsonii* will colonize the mitigation area (as opposed to *H. decipiens* or *Halodule wrightii*). NMFS has listed *H. johnsonii* as a threatened species under Section 4 of the ESA, to date, it has not promulgated a 4d rule under the Act, and as a result, there is no prohibition on take of *H. johnsonii.* There is no critical habitat for *H. johnsonii* in the project area*.*

Smalltooth Sawfish

Effects from Dredging.

Although 16 sightings of sawfish have been made within the boundaries of Broward County, the likelihood of sawfish being in the project area is minimal, as the Port does not provide optimal habitat for sawfish (Simpendorfer 2006). The proposed deepening activities using a cutterhead, clamshell or hopper dredge are not expected to affect the sawfish (NMFS 2003b, as amended).

The assumptions and conclusions regarding cutterhead (pipeline) and mechanical (clamshell) dredges in the 1991, 1995 and 1997 South Atlantic Regional Biological Opinions (SARBO) and 2003 (as amended) Gulf Regional Biological Opinion (GRBO) (NMFS, 1991; NMFS 1995; NMFS 1997; and NMFS 2003) for sea turtles apply to sawfish as well. The 1991 SARBO states:

> "Clamshell dredges are the least likely to adversely affect sea turtles because they are stationary and impact very small areas at a given time. Any sea turtle injured or killed by a clamshell dredge would have to be directly beneath the bucket. The chances of such an occurrence are extremely low, although a take of a live turtle by a clamshell dredge has been documented at Canaveral. On the basis of the best available information, NMFS has determined that dredging with a clamshell dredge is unlikely to result in the take of sea turtles."

> "…pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have approach the cutterhead and be caught in the suction. This type of behavior would appear unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely affect sea turtles."

The 2003 GRBO states…

> "In contrast to hopper dredges, pipeline dredges are relatively stationary, and therefore act on only small areas at any given time. In the 1980s, observer coverage was required by NOAA Fisheries at pipeline outflows during several dredging projects deploying pipeline dredges along the Atlantic coast. No turtles or turtle parts were observed in the outflow areas. Additionally, the COE's South Atlantic Division (SAD) office in Atlanta, Georgia, charged with overseeing the work of the individual COE Districts along the Eastern Seaboard from North Carolina through Florida, provided documentation of hundreds of hours of informal observation by COE inspectors during which no takes of listed species were observed. Additional monitoring by other agency personnel, conservation organizations, and the general public has never resulted in reports of turtle takes by pipeline dredges."

Corps concludes that if this statement holds true for species that are relatively abundant in South Florida like sea turtles, it should also hold true for a very rare species like sawfish.

In the 2003 GRBO, NMFS made the following determination

> "After consultation with individuals with many years in the business of providing qualified observers to the hopper dredge industry to monitor incoming dredged material for endangered species remains (C. Slay, Coastwise Consulting, pers. comm. August 18, 2003) and a review of the available scientific literature, NOAA Fisheries has determined that there has never been a reported take of a smalltooth sawfish by a hopper dredge, and such take is unlikely to occur because of smalltooth sawfishes affinity for shallow, estuarine systems."

The probability of a sawfish being taken by a cutterhead, mechanical or hopper dredge is so unlikely as to be discountable. To help minimize the potential for sawfish take, the Corps will incorporate the NMFS sawfish protection construction protocols into the plans and specifications. All depth alternatives would result in the same impact to smalltooth sawfish as discussed for the TSP.

Based on the information included in the recovery plan, the census information from FWC and NMFS and the proposed construction techniques, Corps determined that the expansion of Port Everglades using a cutterhead, clamshell or hopper dredge may affect, but is not likely to adversely affect the endangered smalltooth sawfish.

NMFS also came to this determination in the recently completed Biological Opinion for Miami Harbor (F/SER/2011/00029) stating:

> "NMFS has identified the following potential effects to smalltooth sawfish and has concluded that sawfish are not likely to be adversely affected by the proposed action. Effects on sawfish include the risk of injury from dredging activities, although there has never been a reported take of a smalitooth sawfish by any type of dredge. Smalltooth sawfish may be affected by being temporarily unable to use the site due to potential avoidance of construction activities and related noise, and physical exclusion from areas contained by turbidity curtains, but these effects will be insignificant. Disturbance from construction activities and related noise will be intermittent and only for part of the construction period; turbidity curtains will only enclose small areas at any one time in the project area, will be removed upon project completion, and will not appreciably interfere with use of the area by sawfish. Due to the species' mobility and the implementation of NMFS' Sea Turtle and Smalltooth Sawfish Construction Conditions, the risk of injury will be discountable."

Effects of Blasting.

Review of ichthyological information and test blast data indicates that fishes with swim bladders are more susceptible to damage from blasts, and some less-tolerant individuals may be killed within 140 feet of a confined blast (USACE 2000). Sawfishes, as chondrichthyans, do not have air bladders, and, therefore, they would be more tolerant of blast overpressures closer to the discharge, possibly even within 70 feet of a blast (Keevin and Hempen 1997). Based on this information, and the rarity of the species in the project footprint, the Corps believes that impacts to sawfish associated with blasting will be minor and discountable.

NMFS also came to this determination in the recently completed Biological Opinion for Miami Harbor (F/SER/2011/00029) stating "Therefore, NMFS believes that the effects on sawfish from blasting will be insignificant."

Indirect Effects on Habitat.

Although seagrass and other soft bottom habitats will be removed, Corps does not anticipate that the proposed project will have any adverse indirect effects on smalltooth sawfish in the vicinity of the action area. These habitats may be utilized by the species, however, loss of seagrass habitats is relatively small with respect to overall seagrass abundance throughout the area, and will be compensated through mitigative measures that have already begun to show increases in seagrass coverage in West Lake Park associated with the first phases of restoration efforts (Dylan Larson, pers comm., August 2011). Nearshore softbottom areas are also plentiful in and near the action area, and impacts to them would not limit resource use by sawfish, especially since population density of individuals in the area is extremely low. Construction of gaps in the rip-rap as part of the environmentally friendly bulkheads along the SAC and TN will ensure that juvenile sawfish, will have access to the existing mangroves on the western shoreline of JUL and the western side of the SAC some of which currently have no access due to the height of the rip-rap along the front of the mangroves, as well as any new mangroves that colonize the shoreline behind the EFBs, which would increase available mangrove habitat.

Sea Turtles

Since beaches of JUL provide important nesting areas for four sea turtle species and the offshore areas provide foraging ground for five listed sea turtle species, the project area comprises important resources for turtles. The project allows for a shift from smaller, less efficient ships, to larger, more efficient ships carrying more cargo without increasing the overall number of vessel calls, or even resulting in a decrease in overall vessel calls. Due to the widening and deepening components of the project, larger container, petroleum, bulk cargo and cruise vessels will call at Port Everglades and more tonnage will be carried per vessel call. The widened and deepened channels may provide sea turtles more room to maneuver around incoming and outgoing vessels throughout the action area, and avoid vessel strikes. Dredge activities and associated disturbances (noise, lights, etc.) offshore may interrupt the movement of turtles swimming toward or away from nesting beaches.

Free-swimming turtles.

If a hopper dredge is utilized to clear shoaling material from the top of rock prior to dredging the rock within Port Everglades, Corps will comply will all terms and conditions for the use of hopper dredges in the Biological Opinion for this project to assure that incidental take of sea turtles are minimized during hopper dredging operations. A rigid-draghead designed to deflect sea turtles is required for all hopper-dredging projects throughout the year in South Florida, due to the year-round presence of sea turtles. The South Atlantic Regional Biological Opinion (NMFS 1997) mandates that year round, 100 percent observer coverage on the hopper dredge by NMFS-approved Endangered Species Observers is required for the Port Everglades project, if a hopper dredge is used during project construction. One-hundred percent inflow screening is required, and 100 percent overflow screening is recommended. If conditions prevent one hundred percent inflow screening, inflow screening can be reduced, but 100 percent outflow screening is required, and an explanation must be included in the preliminary dredging report. Preliminary dredging reports which summarize the results of the dredging and any sea turtle take must be submitted within 30 working days of completion of any given dredging project. Logs of any sea turtle injuries or deaths due to hopper dredging activities will be maintained, with immediate notification by the contractor to Corps-Jacksonville District, and NMFS. NMFS has previously determined (NMFS 1991, 1995, 1997 and 2003 as amended that pipeline and clamshell dredges are not likely to take sea turtles (NMFS, 1991):

> "Clamshell dredges are the least likely to adversely affect sea turtles because they are stationary and impact very small areas at a given time. Any sea turtle injured or killed by a clamshell dredge would have to be directly beneath the bucket. The chances of such an occurrence are extremely low, although a take of a live turtle by a clamshell dredge has been documented at Canaveral. On the basis of the best available information, NMFS has determined that dredging with a clamshell dredge is unlikely to result in the take of sea turtles."
>
> "…pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have approach the cutterhead and be caught

> in the suction. This type of behavior would appear unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely affect sea turtles."

A hopper dredge was previously used in the entrance channel and inner portions of the Port in 2005 for two separate dredging events. A total of 200 loads over a three-month period resulted in no documented lethal or injurious take of sea turtles during dredging operations. The following websites provide useful data:

- http://el.erdc.usace.army.mil/seaturtles/project.cfm?Id=442&Code=Project
- http://el.erdc.usace.army.mil/seaturtles/project.cfm?Id=403&Code=Project

As part of the standard plans and specifications for the project, Corps has agreed to implement the NMFS "Sea Turtle and Smalltooth Sawfish Construction Conditions," as detailed above in the section discussing sawfish. Additionally, the Corps will include all terms and conditions from the SARBO (1997) regarding vessel lighting and sea turtles, including the following:

> "From May 1 through October 31, sea turtles nesting and emergence season, all lighting aboard hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches shall be limited to the minimal lighting necessary to comply with U.S. Coast Guard and/or OSHA requirements. All non-essential lighting on the dredge and pumpout barge shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to minimize illumination of the water to reduce potential disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches."

As part of this effort, the Corps conducts lighting surveys of the contractor's dredges when they arrive on site, and require the contractor to meet all USCG and/or OSHA requirements. This process will be adhered to for the Port Everglades project. As previously stated by USFWS in their Fish and Wildlife Coordination Act Report, the Port is an active facility, offshore lighting is not an unusual feature of the area, and should not appreciably change the ambient conditions for free-swimming turtles in the vicinity of the project. In addition, all construction/dredging vessels are required to adhere to best management practices, such as preventing lights from exposure to shore through use of shields. Therefore, no adverse indirect impacts to free swimming sea turtles due to lighting associated with dredging operations are anticipated for the proposed project.

The highest potential impact to sea turtles may be the use of explosives to remove areas of rock within the Port. It has been documented that the pressure and noise associated with unconfined blasting can physically damage sensory mechanisms and other physiological functions of individual sea turtles (Keevin and Hempen 1997). Impacts associated with blasting can be broken into two categories: direct impacts and indirect impacts.

Direct Impacts.

To-date, there has not been a single comprehensive study to determine the effects of underwater explosions on reptiles that defines the relationship between distance/pressure and mortality or damage (Keevin and Hempen 1997). However, there have been studies, which demonstrate that sea turtles are killed and injured by underwater explosions (Keevin and Hempen 1997). Sea turtles with untreated internal injuries would have increased vulnerability to predators and disease. Nervous system damage was cited as a possible impact to sea turtles caused by blasting (U.S. Department of Navy 1998 as cited in USACE 2000). Damage of the nervous system could kill sea turtles through disorientation and subsequent drowning. The Navy's review of previous studies suggested that rigid masses such as bone (or carapace and plastron) could protect tissues beneath them; however, there are no observations available to determine whether the turtle shells would indeed afford such protection. Studies conducted by Klima *et al.* (1988) evaluated unconfined blasts of only approximately 42 pounds on sea turtles (four ridleys and four loggerheads) placed in surface cages at varying distances from the explosion. Christian and Gaspin's (1974) estimates of safety zones for swimmers found that, beyond a cavitation area, waves reflected off a surface have reduced pressure pulses; therefore, an animal at shallow depths would be exposed to a reduced impulse. This finding, which considered only very small-unconfined explosive weights, implies that the turtles in the Klima *et al.* (1988) study would be under reduced effects of the shock wave. Despite this possible lowered level of impact, five of eight turtles were rendered unconscious at distances of 229 to 915 meters from the detonation site. Unconscious sea turtles that are not detected, removed and rehabilitated likely have low survival rates. For CU blasting, these types of effects would not have occurred, due to the significantly reduced pressures associated with CU blasting. The proposed action will use CU blasts, which will significantly reduce the pressure wave strength and thus area around the discharge where injury or death may occur (Hempen *et al*. 2007). The Corps assumes that tolerance of turtles to blast overpressures is approximately equal to that of marine mammals (Department of the Navy 1998 in USACE 2000), *i.e.*, death would not occur to individuals farther than 400 feet from a confined blast (Konya 2001).

For assessing impacts of blasting operations on sea turtles, Corps relied on the previous analysis conducted by NMFS-OPR as part of their ESA consultations on the Miami Harbor GRR [NMFS Consult # F/SER/2002/01094] (NMFS 2003a); Miami Harbor Phase II project [NMFS Consult #I/SER/2002/00178] (NMFS 2002) as well as the results from the blasting conducted at Miami, where 16 sea turtles were recorded being in the action area during the 38-days when blasting occurred, without a single stranding of an injured or dead turtle being reported (Trish Adams, FWS pers.com, 2005; Wendy Teas, NMFS, pers.com 2005; Jordan *et al*. 2007). In both of the ESA Consultations for the two projects in Miami, with regard to impacts to sea turtles, NMFS found that, "NOAA Fisheries believes that the use of the mitigative measures above in combination with stemming the hole the explosives are placed in (which will greatly reduce the explosive energy released into the water column) will reduce the proposed action's effects on sea turtles to insignificant levels." (NMFS 2003a and 2002).

Pressure data collected during the Miami Harbor project in 2005 by Corps geophysicists and biologists showed that using the four zones previously described, the pressures associated with the blasts return to background levels (1-2 psi) at the margin of the danger zone. This means that any animal located inside the exclusion zone, but outside the danger zone would not be exposed to any additional pressure effects from a confined blast (Hempen *et al*. 2007).

Indirect Effects due to Construction.

Indirect impacts on sea turtles due to dredging/blasting and construction activities in the project area include alteration of behavior. For example, daily movements of sea turtles may be impeded or altered. Based on the protective measures proposed for this project, in concert with the reduction in pressure from the blast due to the confinement of the pressure in the substrate, the impacts to sea turtles associated with blasting should be minimal.

Indirect Effects due to Removal of/Damage to Resting/Foraging Habitat.

Removal of approximately 16.64 acres of middle and outer reef associated with the project entrance channel expansion will remove foraging habitat for any of the five sea turtle species known to be in Broward County. Based on a GIS analysis of habitat types (Walker *et al.* 2007), the project will remove 0.08% of the middle reef (shallow colonized pavement & linear reef middle tract) and 0.54% of the outer reef (deep colonized pavement; linear reef outer tract; spur & groove reef) foraging habitat within Broward County by expansion of the outer entrance channel (Figure 32 and Table 6). Although Walker's minimum mapping unit was limited to the 1-acre level, and the project impacts are assessed at a more detailed level, a more detailed assessment of all the impact categories throughout all of Broward County is not likely to change the results significantly. The removal percentages would also decrease significantly if the calculations included existing middle and outer reef habitats in the adjacent counties of Miami-Dade and Palm Beach available for sea turtle foraging. Removal of this habitat, while small in the overall county-wide assessment of available foraging habitat, will permanently remove this habitat from the project area, and while mitigation is planned to be provided for the reef impacts, there is no guarantee that sea turtles in the project area will be able to utilize that mitigation as foraging habitat.

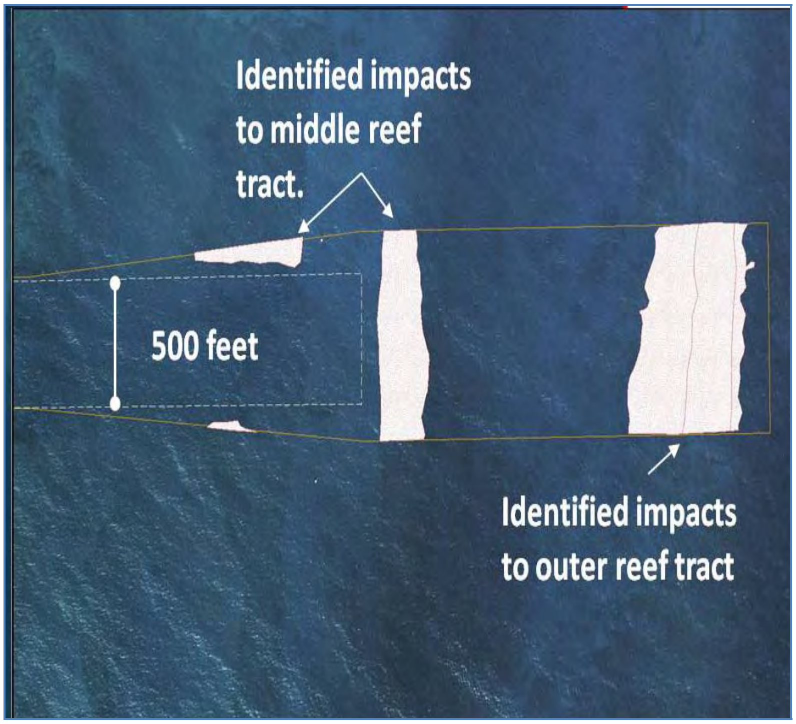


Figure 32 - Direct removal of sea turtle foraging habitat

Foraging habitats may also suffer some indirect effects, including temporary increases to turbidity and sedimentation on foraging habitat within the indirect impact zone for the project (the area within 150 meters surrounding the impact footprint). However, implementation of BMPs should reduce potential impacts, and they are not expected to be any greater than the effects of sedimentation and turbidity commonly experienced in this area due to the passage of storms (Pennekamp *et al.* 1996).

Table 6 - Relative Amount of Permanent Foraging Habitat Removal for Sea Turtles Due to Proposed Plan

Position and Habitat	Parameter	Coverage (ac)	Proportion (%)
Middle reef tract: shallow colonized pavement and linear reef habitats	Projected direct impact	5.56	
	Total available in Broward County	6,383	
	Relative impact		0.087
Outer reef tract: deep colonized pavement, linear reef, and spur and groove habitats	Projected direct impact	10.65	
	Total available in Broward County	1,958	
	Relative impact		0.54

Note: Acreage totals based on Walker *et al*. 2007 data

Direct Effects of each Construction Method on Acropora Critical Habitat

As previously stated, to date, colonies of *Acropora cervicornis* and *Acropora palmata* have not been located in either the direct or indirect impact areas of the project. Although *Acropora cervicornis* and *Acropora palmata* have not been located in the project footprint, or adjacent indirect impact zone, we recognize that this may change between the finalization of this consultation and initiation of construction dredging by the species migrating into the project footprint or that a colony less than 1-2 years old, not visible to the eye during the surveys (NMFS 2005) matures and becomes visible to the naked eye. As we have previously committed to in our letter dated October 18, 2006 and our October 13, 2006 Effects Determination Memorandum, if any *Acropora cervironis* or *Acropora palmata* are located prior to or during project construction, the Corps will implement the protective measures detailed in the Terms and Conditions of the Miami Harbor September 2011 Biological Opinion (F/SER/2011/00029) reinitiate consultation with NMFS under the ESA.

Dredging of the Channel Extension and Flare (All Dredge Types) - Direct Removal of Habitat by any Dredging Methodology

The most significant impact associated with dredging the entrance channel extension is the permanent removal of approximately 5.56 acres of the middle reef and approximately 10.65 acres of the outer reef to create the entrance channel flare as identified as a need for vessel safety. This flare is required due to the variable and unpredictable cross currents that are a result of eddies spinning off of the Gulf Stream located just offshore of the entrance channel as documented by Martinez-Pedraja, *et al.* (2004) and NOS (2010: Coast Pilot). Due to the increased size of the ships currently arriving at the port and the expected continuation of these larger ships to continue to arrive in the future, these cross currents can prove extremely unpredictable and may cause the ship to run aground on either side of the entrance channel. The Draft Feasibility Report for Port Everglades addresses existing issues with safe vessel navigation through the entrance channel due to unpredictable currents and documents. USCG casualty data dating from 1998- 2008 contained 55 casualties in and around Port Everglades due to vessel collisions, allisions or groundings. As a result of these groundings and ship simulations conducted by the Corps in support of the Feasibility study identifies extending the channel seaward 2,200 feet and creating an 800-ft wide mouth of the entrance channel to lessen the likelihood of vessel grounds as a result of these currents.

The DCH requires the presence of ‘‘substrate of suitable quality and availability’’ is equivalent to consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover as a “Primary Constituent Element” (PCE) that must be present for the physical area to be considered DCH. NMFS has not published a standard protocol for assessing the amount of “substrate of suitable quality and availability” to assess the presence of this PCE.

The proposed project’s OEC component will permanently remove approximately 5.56 acres of the middle reef and approximately 10.65 acres of the outer reef to extend the entrance channel and create the flare. There are five hardbottom habitat types found in and adjacent to the existing federal channel and proposed extension and flare (based on Walker *et al.* 2007) that may be classified as designated critical habitat for acroporid species under the ESA:

- Shallow colonized pavement
- Deep colonized pavement
- Linear reef: middle tract
- Linear reef: outer tract
- Spur and groove reef: outer tract

The 5.56 acres of middle reef noted above equates to 0.0225 sq km of middle reef habitat and 10.65 acres of outer reef equates to 0.04310 sq km of outer reef habitat. The Florida unit of DCH is 3,442 sq km in size, adding the two impact figures together (0.0656 sq km) and dividing the impact area by the DCH area results in a determination that 0.00190587 % of DCH in the Florida unit will be permanently removed by the channel extension and widening (Table 7). This percentage assumes that 100% of the substrate is available for colonization, as NMFS defines it in the final rule designating critical habitat, ‘‘substrate of suitable quality and availability’’ meant consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover” (73 FR 72210 – 11/26/2008).

Table 7 - Direct Removal Impact of Designated Acropora Critical Habitat

Habitat type	Acreage/ km	%DCH of Florida unit removed by project – 100% clean substrate available	%DCH of Florida unit removed by project – % clean substrate survey results
Middle reef	5.56 ac (0.0225 sq km)	0.00065369%	0.00028762% (44% “available” substrate)
Outer Reef	10.65 ac (0.0431 sq km)	0.00125218%	0.00033809% (27% “available” substrate)
“Florida Unit” of DCH	3,442 sq km	0.00190587 % (0.0656 sq km)	0.00062571% (0.0215 sq km)

However, data show that there is 56% biotic coverage on middle reef (45% turf algae) and 73% biotic coverage on outer reef (55% turf algae) (DCA 2009) (Table 8).

Table 8- Percent cover of functional group categories as recorded in video belt transects at Port Everglades in 2006 (DCA, 2009)

Reef 2	***Zone 1***	***Zone 2***	***Zone 3***	***Avg***
Turf Algae	59.30	31.09	n/a	45.20
Sediment	16.92	38.60	n/a	27.76
Rubble	12.99	18.50	n/a	15.75
Reef 3	***Zone 1***	***Zone 2***	***Zone 3***	***Avg***
Turf Algae	60.93	52.37	50.56	54.62
Sediment	12.29	27.24	27.88	22.47
Rubble	6.37	2.15	4.34	4.29

This means that a maximum of 44% of the middle reef may be available for settlement of Acropid larvae and 27% of the outer reef may also be available. Calculating the percentages of available habitat, as defined by NMFS, 0.00062571% (0.0215 sq km) of the Florida unit of designated critical habitat available for colonization by Acropid larvae would be permanently removed by the project (Table 7).

Deepening of the entrance channel and dredging the flare is not expected to adversely impact any biological functions of acroporid corals (feeding, breeding, settling, etc). Concern has been expressed that deepening the existing channel and dredging the flare in the third reef may create a "sink" that fragments of acroporid corals could fall into and not escape, thus creating a physical blockage to fragments of acroporid corals moving north with the currents, thus hindering reproduction. The Corps has reviewed the available information on *Acropora sp*. coverage throughout south Florida, with specific attention paid to known colonies of *Acropora sp.* in the vicinity of deep water entrance channels.

The Corps has been unable to discover any research studies, monitoring reports or other publications that discuss this issue in any detail specific to *Acropora* species. There are 13 deepdraft navigation channels; three of which are currently slated to be deepened in the next 2-10 years; located within DCH, and this issue was not identified in the pending draft Recovery Plan for *Acropora* (in press) (that Corps reviewed as part of the recovery plan development team) as a potential hindrance to species recovery. The Corps was able to determine that there are two deepwater entrance channels within 25 miles of each other within DCH for acroporid corals: Miami Harbor and Port Everglades, both of which have been dredged to 45 feet. Miami was initially constructed late in 1905, and Port Everglades was originally constructed in 1927. Miami was deepened to its current depth with deepening resulting in all three offshore reefs being cut, in 1991 and Port Everglades was deepened to -45 feet and widened from 300 feet to 500 feet in 1981. *A. cervicornis* has been documented at Miami Harbor on the southern edge of the entrance channel and additional colonies have been documented on the northern side of the channel, within 200 feet of the channel edge, unlike Port Everglades where the closest documented colonies of *A. cervicornis* are more than 500 feet to the south of the channel and 1,400 feet north of the channel by the Corps and USN surveys. Neither channel has *A. palmata* documented as being in close proximity. Since the early 1980s, *A. cervicornis* has been documented as expanding its range northward through Broward County and into Palm Beach County, into areas previously documented as being devoid of acroporid corals in the 1970s 1980s and even the 1990s and early 2000s, or where acroporid corals were documented as being rare (*A. cervicornis*) or absent (*A. palmata*) (Vargas-Angel *et al.* 2003; Goldberg 1973, Precht and Aronson 2004). There are several natural breaks in the 2nd and 3rd reefs located between the Miami and Port Everglades channels, including one in the third reef that is more than 1,000 meters wide located more than eight km south of Port Everglades and *Acropora cervicornis* has been located north of this natural break on the third reef. Since acroporid species reproduce predominately through fragmentation (NMFS, 2005) and there are natural breaks in the 2nd and 3rd reefs located between the Miami and Port Everglades entrance channel more than seven times wider than the cut proposed for the channel extension (500 feet/ 0.15 km), Corps concludes that these dredged channels, that are narrower in width than natural breaks in the reefs, have not previously hindered, nor will they hinder in the future after deepening, the continued ability of fragments of acroporid coral species to migrate northward and continue to expand the species range in southeast Florida, as habitat conditions warrant.

Hopper Dredging.

If sandy material is present in the outer entrance channel, the Corps may utilize a hopper dredge to remove the sand overburden. This material will be placed in the ODMDS. No direct impacts (breakage, removal or direct burial of *Acropora sp.*) are anticipated from hopper dredging activities associated with the sand removal operations, since the hopper dredge will not leave the channel and there is no known *Acropora sp.* in the Federal channel or on the channel walls. The hopper dredge locations will be monitored at all times via the DQM system, which includes a dredge and scow tracking function. If the dredge leaves the channel, the Corps will be able to determine when and where this occurred and the area can be surveyed for any potential damage or adverse effects. No direct impact to designated critical habitat located north or south of the entrance channel is expected to occur as a result of the use of a hopper dredge. The channel walls and bottom of the existing channel are not designated critical habitat (NMFS, 2008b) since they are considered part of a "maintained channel" as detailed in 50 CFR §226.216 (c)(2).

Clamshell or Backhoe Dredging.

Clamshell dredging environmental impacts in unconsolidated sediment include resuspension of sediments when the clamshell drops onto the bottom and as material washes from the bucket as it rises through the water column. Operational controls such as reducing the bucket speed as it drops to the bottom and as it rises through the water column will reduce impacts, as will use of a closed bucket system.

Backhoe marine excavator dredging environmental impacts in unconsolidated sediment are similar to those of a clamshell dredge, as are the operation controls to reduce that impact. The key is slowing the movement of the bucket through the water. Environmental impacts are significantly less for a backhoe marine excavator dredge removing fractured (blasted) rock as the volume of fine grained sediment is significantly less in fractured rock than unconsolidated sediment and as a result the potential for sediment resuspension is reduced. The same operational controls can be applied to fractured rock as unconsolidated sediment, basically slowing the bucket's speed in the water.

The clamshell and backhoe dredges will "spud down" in the channel proper, and as such, have no direct impacts to hardbottom outside of the channel. No direct impact to designated critical habitat located north or south of the entrance channel is expected to occur by use of a clamshell or backhoe dredge. The channel walls and bottom of the existing channel are not designated critical habitat (NMFS, 2008b) since they are considered part of a "maintained channel" as detailed in 50 CFR §226.216 (c)(2).

Cutterhead Dredging.
Environmental impacts from cutterhead dredges include localized suspended sediment along the bottom of the excavation site around the cutterhead and fine-grained sediment turbidity plumes from barge overflow or pipeline leaks. This can be reduced or eliminated by restricting the amount of overflow time, eliminating barge overflow, and performing regular inspections of the floating pipeline. Locating barges the furthest possible distance from resources can further reduce environmental impacts

Incidental Impacts due to Cutterhead Dredge Equipment.
Anchors are placed to both sides of the dredge to provide the ability to swing the cutterhead dredge. The anchors are placed using a crane on a workboat. If traditional cutterhead dredging is used with unrestricted anchor/cable placement as a construction method to deepen the entrance channel, additional direct impacts to both low relief and high relief hardbottom reefs would occur due to anchoring and cable systems for the cutterhead vessel. If the selected contractor uses the worst-case anchor-cable setup, the anchors will be placed at the apex of each triangle approximately 150 feet from the channel edge and a cable brought back to the dredge. This cable will move along the bottom as the dredge moves forward until it reaches the apex of the triangle. At that time, the anchor would be relocated and the process repeated. Figure 65 provides a worst-case scenario of potential hardbottom impacts with this construction method. The potential exists for up to approximately 17.13 acres of all reef habitat types (inner, middle and outer) as well as nearshore hardbottom and rubble zones to be impacted based on the maximum number of anchor positions with any impacts to hardbottom or coral habitats (A total of 69 anchor placement sites with 54 placed in coral/hardbottom environments), and footprint of cable movement (maximum 0.32-acre impact/anchor site) (Figure 33). The number of anchor sites and the distance of the

anchor from the channel edge, thus the length of cable, may increase or decrease, dependent upon what equipment type and size contractors propose.

Implementation of an anchoring and vessel operation plan to effectively minimize anchor and cable impacts to hardbottom habitat will occur through the Request for Proposal (RFP) process and will include incentives to encourage potential contractors to avoid reef impacts. The evaluation criteria in the RFP will consider the technical aspects of the contractor's proposal as the most significant factor. As a result, the vessel operational and anchoring plan that best avoids or reduces impacts to reefs would receive the highest evaluation and the incentives that follow. Potential ideas provided by dredging companies and other consultants that would probably appear in contractor proposals for evaluation during the RFP process include:

- Use of surge buoys along the anchor cable to help lift it up off the reef areas during dredging operations to minimize the area impacted by the anchor cable; reviewing an assessment of the impacts associated with the 1991 deepening at Miami Harbor where anchors and cables were used in concert with surge buoys, the impact of placement and utilization of each anchor was 0.029 acres. If a contractor proposes a similar method as was used in 1991 during the RFP process, the impact per anchor site would be decreased by approximately 93 percent.
- Restricted anchor placement, which restricts placement of the anchors for the cutter-suction dredge to within the channel edge limits. That method reduces impacts but almost doubles dredging time since only half of the channel can effectively be dredged at a time.

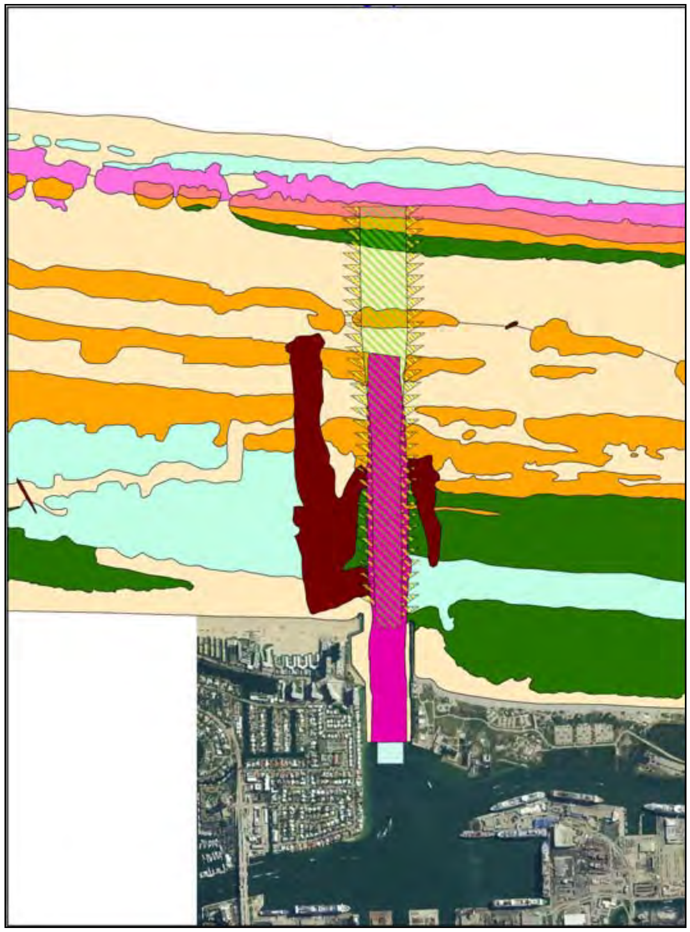


Figure 33 - Anchor/Cable Placement Area for Port Everglades - Traditional Cutterhead Dredge Placement Scheme

If the worst case anchor-cable setup is used by the selected contractor, the anchors will be placed at the apex of each triangle approximately 150 feet from the channel edge and a cable brought back to the dredge. This cable will move along the bottom as the dredge moves forward until it reaches the apex of the triangle. At that time, the anchor would be relocated and the process repeated.

After reviewing the monitoring reports from the 1980 channel deepening at Port Everglades where a traditional anchor/cable configuration was utilized with impact monitoring (CSA, 1981), the Corps determined that although the report states that no adverse impacts associated with the deployment of an anchor/cable configuration were documented, impacts may occur. A review of an Habitat Equivalency Analysis (HEA) conducted for the Hillsboro Inlet navigation district associated with injury to offshore hardground by “cables dragging across or near the reef surface by a barge during… dredging operations” demonstrates the potential for detachment and abrasive injuries to hard corals, octocorals and sponges. To be conservative, the Corps believes that the unrestricted placement of anchor/cables may result in similar impacts (NCRI, 2003). During the damage assessment phase of the HEA, NCRI documented that 2.24% of hard corals in the impact area were injured, 7.7% of octocorals and 34% of barrel sponges. Assuming that *A. cerivcornis* had been located in preconstruction surveys, and relocated any *A. cerivcornis* from the project area, the remaining smaller *A. cerivcornis* colonies would be adversely affected. The Corps has applied the percentage of hard coral impacts from the NCRI, (2003) assessment to any remaining *A. cerivcornis* still in the project area after transplantation is complete. This means that 2.24% of the remaining *A. cervicornis* could be injured by the use of unrestricted anchor/cable placement and for the purposes of this consultation should be considered lethally taken. The movement across the reef by the cable is a onetime event and has no adverse effect on designated critical habitat as it does not remove or alter the physical structure of the substrate, it only impacts the organisms attached to the substrate.

<u>Effects of Rock Pre-treatment/ Confined Underwater Blasting.</u>

A literature review of the effects of open-water blasts on invertebrates (including corals and *Millepora sp*.) by Keevin and Hempen (1997) states the following:

> "The results of all the studies reviewed indicate that invertebrates are insensitive to pressure related damage from underwater explosions. This may be due to the fact that all the invertebrate species tested lack gas-containing organs which have been implicated in internal damage and mortality in vertebrates. Underwater explosion produce a pressure waveform with rapid oscillations from positive pressure to negative pressure which results in rapid volume changes in gas-containing organs. In fish, the swimbladder, a gas-containing organ, is the most frequently damaged organ (Christian 1973; Faulk and Lawrence 1973; Kearns and Boyd 1965; Linton *et al*. 1985a; Yelverton *et al*. 1975). It is subject to rapid contraction and overextension in response to the explosive shock waveform (Wiley *et al*. 1981). Species lacking swimbladders or with small swimbladders are highly resistant to explosive pressures (Aplin 1947; Fitch and Young 1948; Goertner 1994). For example, Wiley *et al*. (1981) and Goertner *et al*. (1994) noted that hogchokers (*Trinectes maculatus*), which lack swimbladders, were extremely tolerant of underwater explosions, and greatly exceeded the tolerance of any species with swimbladders that they had tested. Goertner *et al*. (1994) found that hogchokers were not killed beyond a distance of 1-m from a 4.5 kg charge of pentolite.
>
> "Gas-containing organs have also been implicated as a causative factor of internal damage and mortality in other vertebrate species exposed to underwater explosions. Sailors exposed to depth charges and torpedo explosions, while escaping their sinking ships during World War II, suffered damage to gas-containing organs (Cameron *et al*. 1944; Ecklund 1943; Gage 1945; Palma and Uldall 1943; Yaguda 1945). The lungs, stomach, and intestines, all gas-containing organs, were ruptured or hemorrhaged, while other organs were relatively unaffected. Similar results have been observed in underwater explosion tests with other mammalian species (Richmond *et al*. 1973)."

Based on the fact that acroporid corals are invertebrates, and lack gas containing organs like swim bladders, lungs, etc., and that no acroporid corals have been documented in the project footprint, the Corps concluded that pre-treatment of hard rock in the outer entrance channel with confined blasting would not have any impact on acroporid corals. NMFS concurred with this determination in the September 2011 Biological Opinion issued for the expansion of Miami Harbor where *A. cerivcornis* has been documented directly adjacent to the channel.

Additionally, the Corps will be conducting sedimentation and turbidity monitoring in the project area, adjacent to the blast sites that will detect any potential effects of blasting on small acroporid colonies discovered during pre-construction surveys, yet not transplanted out of the project area before construction due to size. This data will be recorded and could be utilized by NMFS and the Corps for future consultations where pre-treatment of hard rock is needed throughout the range of acroporid corals.

Indirect Impacts to Critical Habitat

Although there is published literature concerning the effects of sedimentation and turbidity on coral reefs throughout the world, there is a paucity of peer reviewed published data specific to the recent dredging events that have taken place in southeast Florida. There are numerous published papers specific to Caribbean coral reefs that in context can be applied to corals in Florida (Rogers 1983; Rogers 1990; Dodge and Vaisnys 1977, Bak 1978), however, peer-reviewed literature specific to monitoring of dredging projects in south Florida is very limited. Corps reviewed four monitoring reports and two peer reviewed studies from recent projects in documented *Acropora* habitat between 1980 – 2007 where sedimentation and turbidity data were collected not only at sites adjacent to the channels or borrow sites, but also from background sites so that potential indirect impacts associated with dredging could be detected in addition to background impacts from natural events.

The four projects that were reviewed were: (1) Port Everglades entrance channel widening and deepening project conducted in 1980-1981; (2) Broward County Shore Protection Project conducted in 2005; (3) Key West Harbor O&M dredging 2004-2006 and (4) Key West Harbor O&M dredging 2007 (Jordan *et al*. 2010; Gilliam *et al*. 2006; Fisher *et al.* 2008; CSA 2007; CSA 2007a and CSA 1981). These projects utilized cutterhead, hopper, and clamshell dredges (or a combination thereof) for their operations.

From a turbidity and/or sedimentation standpoint, a hopper dredge has the highest likelihood of adverse effect due to the overflow of water being returned from the hopper to the surrounding environment. With this overflow, "fines" (usually clays or silts which are light enough not to have settled out in the hopper) are returned to the water during dredging operations. The clamshell or bucket dredge ranks second since the material may or may not be enclosed in a bucket, and if it is not enclosed, material may escape that bucket into the surrounding environment. The dredging method with the lowest level of associated sedimentation or turbidity is the cutterhead dredge. This dredge has suction that removes the sediment, transports it to the surface where it is either pumped into the receiving disposal site, or placed in a scow for transport to a disposal site. The Key West O&M projects in 2004-2006 and 2007 utilized both a clamshell dredge and a hopper dredge. The Broward County Shore Protection Project utilized a hopper dredge and the Port Everglades expansion project in 1980 utilized a cutterhead dredge. Understanding which types of equipment were utilized allows for a comparison across projects of results regarding turbidity and/or sedimentation monitoring.

A review of these four projects found that using BMPs for turbidity and sedimentation control (e.g. ceasing dredging when turbidity levels exceed permitted standards) are protective of the coral and hardground environments surrounding South Florida sand borrow sites and navigation channels. Impacts associated with storms can have sedimentation rates in excess of 400 times those seen with a dredging project. The following information is provided from the Key West Harbor O&M project. (CSA 2007):

> "Average daily sedimentation rates at the monitoring sites fluctuated based on weather conditions and ambient suspended sediment load in the surrounding waters. This was especially evident during periods of winter cold-front activity during November 2005 and January 2006, with associated rough seas and high turbidity. During these periods, average daily sedimentation rates were more than twice as high as during the previous November and January, and up to 25 times above levels observed during June 2004 at several sites. The passage of hurricanes during August and September of 2004 and July, September, and October of 2005 provided the most dramatic increase in levels of sediment re-suspension (Figures 3.23 to 3.25 [Figures 32]). Average daily sedimentation rates at several of the Hawk Channel seagrass sites and the bank reef sites were up to 400 times higher than levels noted during June 2004. Following Hurricane Dennis in July 2005, nearly every sediment trap site had at least a ten-fold increase in the average daily sedimentation rate compared to the previous month.
>
> "Site BP-41, a bank reef monitoring site adjacent to the Main Ship Channel, had an average daily sediment deposition rate of 18 mg/cm^2/day for August 2005, while in the following month when Hurricanes Katrina and Rita impacted the area, the average daily sediment deposition rate recorded in the traps increased to 1,219 mg/cm^2/day, 67 times the previous month's level. For Site SP-37, a seagrass site located adjacent to the Main Ship Channel, there was an increase in average daily sediment deposition rate during this same period from 14.4 mg/cm^2/day up to 3,529.7 mg/cm^2/day, 245 times the August levels."

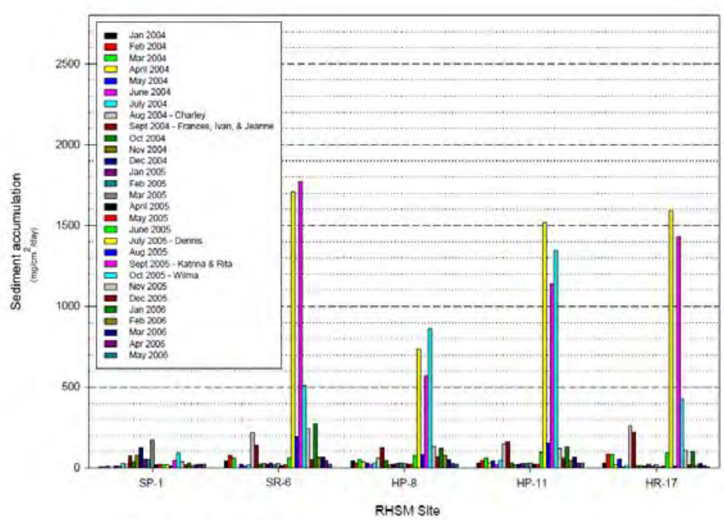


Figure 3.23. RHSM Sites SP-1 to HR-17 sediment trap data for January 2004 through May 2006.

Figure 34   Key West RHSM Sites SP-1 to HR-17 sediment trap data (January 2004 - May 2006)

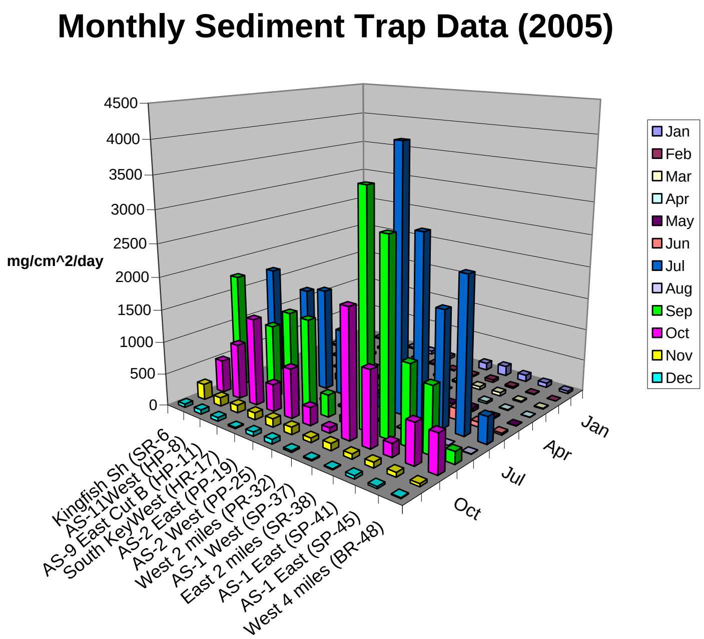


Figure 35 - Monthly Sediment Trap Data - Key West O&M 2005

Additionally, Gilliam *et al. (*2006) and Fisher *et al.* (2008), found there to be no detectable impacts to corals living on the hardgrounds adjacent to the borrow areas utilized for the Broward County shore protect project. While the Key West and Broward County projects were required by regulatory permit to maintain a lower turbidity threshold (15 NTUs), a review of the monitoring from the Port Everglades channel widening and deepening from 1980-1981 continues this trend in showing little to no effect of dredging operations on corals adjacent to dredging areas (CSA, 1981). The Port Everglades deepening project in 1980-1981 was not bound by any state or federal agency issued turbidity level that required the dredge to cease operations. The Corps did monitor turbidity and sedimentation levels throughout the dredging operations, which is most similar in nature to the dredging currently proposed, and the final report for the Port Everglades deepening conducted states, “Due to the powerful suction ability of the dredge, only a small fraction of the dredged material entered the water column. No significant increase in turbidity levels was detected during daily monitoring of the dredging operations by U.S. Army Corps of Engineers environmental contractor.” (CSA 1981).

The examples of the adverse effects of turbidity or sedimentation on coral species often cited by resource managers are commonly projects in third world countries without the strict water quality protections that are in place in the U.S. (Bak 1978); or are studies where the material used to simulate dredged material is not the same sediment size or mineral composition of the material proposed to be dredged (Telesniki and Goldberg

1995) and thus are not a good substitute for the effects of projects bound by the water quality restrictions required by the State of Florida under the Clean Water Act. These restrictions are protective of water quality by limiting turbidity; they are also protective of coral species, including *Acropora sp.* and its designated critical habitat, located near dredging operations where material is being removed from the bottom by a dredge. Dredging projects take place in a spatially and temporally finite area and thus impacts associated with them, if present, should be detectable within this same finite footprint. A review of these four projects, three of them in the very recent past, demonstrates that no adverse effects of dredging were detectable (or in the case of Broward county were detectable as monitoring continues) (Gilliam *et al.* 2006; Fisher *et al.* 2008; Jordan *et al.* 2010; CSA 2007; CSA 2007a; CSA 1981).

Of the four projects, only the Key West O&M project documented any acroporid corals adjacent to dredging areas, which may be attributable the lack of focus on *Acropora* on the other (and, indeed, most) projects prior to the listing of the two species under the ESA. Between the two dredging projects in Key West, *A. cervicornis* was documented along the east side of the Key West entrance channel near station BP-41. The 2007 dredging event took approximately four months between May and August. These colonies did not show any impacts different than control corals (CSA 2007) and none of the recorded changes were attributed to the dredging.

To protect hardgrounds in project areas including those that support *A. cervicornis*, the Corps requires turbidity monitoring with all of its projects. It is a standard practice for the Corps to monitor sedimentation associated with dredging projects where corals and coral habitats are adjacent to the project area. This has been standard practice for more than 30 years (CSA 1981; CSA 2007; CSA 2007a).

In the 2009 biological opinion for dredging associated with sand mining dated October 21, 2009 (Consultation # F/SER/2009/00879), NMFS reviewed effects of sedimentation associated with *A. cervicornis*. NMFS states:

> "Additionally, Rogers (1983) tested sedimentation rates on *A. cervicornis*, among other coral species, and determined that daily doses of sediment at a rate of 200 mg/cm2/day had no effect (Rogers 1990)."

Given the strong similarities between the proposed action and the Key West and Port Everglades projects previously reviewed, we believe it is reasonable to assume the impacts documented at the Key West and Port Everglades sites will be similar to those likely to occur during the proposed action. Adverse affects from sedimentation are also less likely to occur in the presence of strong oceanographic currents (Rogers 1990) because sediments are swept off corals. This phenomenon was also observed at the Port Everglades project in 1980. The influence of the relatively strong Gulf Stream in the action area is also likely to reduce any adverse affects from sedimentation.

Concern has been raised that the Corps is utilizing data from a project (Key West) that had restrictions on the maximum allowable NTUs (15) that are lower than those that will be required for Port Everglades (29 NTU). The specific concern is that higher turbidity values allow for higher sedimentation rates on adjacent habitats, however, the scientific literature does not support this concern. There is no direct correlation between turbidity and sedimentation rates, or between turbidity and total suspended solids that can be uniformly applied across differing projects (Davies-Colley and Smith, 2001; Clarke and Wilber, 2008). The effects of sedimentation are a dose-response relationship, and the results of that relationship specific to dredging projects in SE Florida has been reported here – both at the 15 NTU and 29 NTU levels, and for both levels, the effects of sedimentation, with proper *in situ* monitoring, showed no adverse effect on coral species in general (Port Everglades and Broward County), and specifically *Acropora sp*. (Key West) near dredging projects. The Port Everglades expansion project (like Key West and Miami) will include sedimentation monitoring as a project component. The substrates being dredged are composed of limestone (calcium carbonate) rock, and as cited by NMFS in 2011, Torres (2001) found

> "In sites with higher carbonate percentages and corresponding low percentages of terrigenous sediments, growth rates were higher. This suggests that resuspension of sediments and sediment production within the reef environment does not necessarily have a negative impact on coral growth while sediments from terrestrial sources increase the probability that coral growth will decrease, possibly because terrigenous sediments do not contain minerals that corals need to grow."

Since the rates of sedimentation observed during the Key West and Port Everglades deepening monitoring were within the bounds of sedimentation documented to be occurring naturally, and those were far less than this 200 mg/cm2/day threshold set by Rogers (1983) cited by NMFS (2009) as a daily dose threshold, we believe adverse effects to *A. cervicornis* and designated critical habitat from increased sedimentation will be insignificant. This determination is consistent with NMFS' previous findings in NMFS biological opinions (2009, 2011) where in both cases NMFS determined the effects of sedimentation on critical habitat to be temporary in nature.

Dredged Material Disposal Impacts. Potential barge environmental impacts could occur as the barge is loaded if material is allowed to spill over the sides and during transport if the barge leaks material. Operational controls eliminate spilling material during loading by monitoring the dredge operator to make sure that the dredge bucket swings completely over the barge prior to opening the bucket. Requiring barges in good repair with new seals minimizes leaking during transport. Hauling rock is often damaging to transport barges, so intermediate inspection and repairs may be required during the project to maintain the barges in good working condition. Seals may require replacement. Proper use of the ODMDS minimizes the environmental impacts during disposal. The barges will be required to use positioning equipment to place dredged material within the designated ODMDS and inspectors may be required to monitor disposal activity. The Corps's required monitoring of vessels in ullage and location ensure that the dredged material is being disposed of in the approved location. Disposal of dredged material will have no impact on *Acropora sp*. corals or DCH. The ODMDS is not within the boundaries of DCH as the site is located offshore of Fort Lauderdale, beyond the edge of the continental shelf in greater than 500 feet of water.

Sedimentation and Turbidity Monitoring. Monitoring of the Port Everglades expansion project will take place on numerous levels including physical monitoring of scow and dredge location relative to reefs and other mapped resources and turbidity and sedimentation monitoring during construction. Monitoring protocols will adapt aspects from other monitoring projects previously referenced, including Key West O&M (CSA 2007; CSA 2007a); Broward County SPP (Gilliam *et al*. 2006 and Fisher *et al.* 2008) and Miami Harbor that is scheduled to begin construction in 2013. Corps will develop detailed monitoring plans prior to construction with the contractor and local sponsor, as well as the federal, state and local resource agencies, and expects NMFS-OPR staff to participate in the development of those plans.

Effects on Designated Critical Habitat by Disposal Activities

As previously detailed, the ODMDS is beyond the 30 meter contour. If the Corps opts to build an artificial reef site as compensatory mitigation for unavoidable impacts of the project on the 2nd and 3rd reef this reef would be potentially be built in the sand trough located between the 2nd and 3rd reef. The mitigation will be constructed with either rock mined from the entrance channel, or native limestone purchased from a quarry. Based on HEA, a total of 37.5 acres of artificial reef would be required to offset unavoidable impacts associated with the TSP. At this time, the Corps is planning on constructing artificial reef for this mitigation, however, Broward County has recently request the Corps review additional mitigation options in lieu of reef construction. The Corps is considering the options presented by the County. Per the final mitigation plan included in the FEIS:

> Two types of mitigation reefs will be constructed: High Relief, High Complexity (HRHC) reefs (exceeding three feet of vertical relief) and Low Relief, Low Complexity (LRLC) reefs (approximately three feet of relief), based on data collected in 2006 (DC&A 2009). The HRHC reefs are intended to mitigate for impacts to high relief habitat (i.e., linear or spur-and-groove reefs) and the LRLC reefs are intended to mitigate for impacts to lower relief reef (i.e., pavement or channel wall) and hardbottoms outside of the project footprint (i.e., in the indirect effect area). The two reef types will be deployed in acreages proportional to direct impacts expected to each type of natural reef habitat. The ratio of HRHC to LRLC is 60%/40%.
>
> Limestone rock excavated from the STB, MTB, IEC, and the OEC may be used in reef construction and, if necessary, supplemented with quarried limestone. Hence, rock excavation will commence inside the harbor to create habitats at selected mitigation sites, and then proceed to dredging the entrance channel; i.e., dredging and reef installation will occur simultaneously. The construction contractor will be allowed the option of purchasing quarried native limestone in lieu of quarrying the material from within the project boundaries. HRHC reefs will consist of limestone rock boulders from 1.0 to 10.0 ton each, having a minimum density of 140 pounds per cubic foot. The material will be deployed in shore-parallel strips 50-100 feet wide to mimic the orientation of typical natural reefs. This reef design will have a vertical relief of 3-6 feet and boulders will be partially stacked to provide the maximum structural complexity and to provide

> refugia for cryptic and reclusive species. As interstitial sand patches associated with reef habitat are thought to be important in the ecological function of the reef habitat, the reef footprint will contain approximately 20 percent open sand surface. Temporary buoys delineating the deployment strip will mark areas for deployment. Corner buoys for the sites shall be placed using DGPS with sub-meter accuracy. Natural limestone provides an ideal substrate for the establishment of a reef community. An additional advantage of limestone rock boulders is aesthetic. Once colonized by the reef community, the reef is almost indistinguishable from a natural reef, enhancing its value as a recreational resource. HDHC reefs are intended to provide persistent habitat with higher complexity and habitat diversity than typical natural nearshore hardbottom reefs. It may also be desirable to include prefabricated structures such as Reef Balls™ in the HRHC reef arrays. These modules, which provide a high degree of complexity and void space, are widely used in artificial reef construction and have proven stable in shallow water applications.

This is the same type of artificial reef that is being constructed as part of the Miami Harbor expansion that NMFS reviewed under the September 2011 Biological Opinion. Construction of these mitigation reefs can also serve as potential habitat for Acroporid corals to settle onto, since they will be bare limestone, although they would not be considered DCH per 50 CFR 226.216(c)(2). Additionally, the site could be used in the future by Broward County, or other permitted organizations to transplant corals from other impactive projects. During construction, a buffer between the selected sites and any adjacent hardground habitats will be maintained at all times to ensure no adverse impacts associated with mitigation construction. Monitoring of the mitigation reefs will consist of both physical and biological components.

As the artificial reef site would be placed on sandy substrate, the Corps believes that such a site would lack the exposed rock or hardbottom necessary to find that the placement areas contain the PCE for Acroporid coral critical habitat as detailed in the final rule (NMFS, 2008b). Additionally the monitoring of the surrounding hardbottom habitats will ensure no adverse effects occur during construction.

Effects of Transplantation

Although no *Acropora* sp. have located in the project direct or indirect footprint, the Corps can conceptually estimate impacts to *Acropora*, should it be located after this consultation is complete, either before or during construction. Prior to initiation of any dredging activities, the Corps will require the contractor to perform a baseline survey of the project area and should they locate an Acropora in the project direct or indirect footprint, they will be required to relocate any *Acropora sp.* colonies greater than 10cm located within 150 meters of the outer entrance channel in accordance with Appendix A of "*Acropora cervicornis* Transplantation Protocols for Miami Harbor Expansion Project" Endangered Species Act - Section 7 Consultation Biological Opinion for Dredging and expansion of Miami Harbor, Miami-Dade County, Florida (Consultation Number F/SER/2011/00029) (NMFS 2011).

This transplantation effort would be consistent with reasonable and prudent measures included in recent biological opinions for beach nourishment and harbor deepening activities (NMFS 2009; NMFS 2011) where *A. cervicornis* was in the action area and is expected to reduce the effect of the anticipated take. Collection of small *A. cervicornis* fragments (i.e., approximately 3-cm fragments) from each transplanted coral would be required to help achieve recovery goals for the species. The fragments will be grown in nurseries by either Broward County or another permitted nursery, increasing population sizes and protecting genetic diversity. These fragments will be collected via careful breaking of the branch tips of the coral colonies using pliers or other small hand tools, or will be fragments of opportunity created during transplantation. The collections will be made by coral experts and trained professionals. Even though these actions involve directed take of *A. cervicornis*, they constitute a legitimate take reduction method (and NMFS has previously included this as a Reasonable and Prudent Measure) because it reduces the level of potential lethal take of *A. cervicornis* during the deepening of the entrance channel by cutterhead dredge, and allows the colonies to be collected and relocated out of the impact area where they will have a high likelihood of continued survival. The Consultation Handbook (USFWS and NMFS 1998) expressly authorizes such directed take as an RPM (see page 4-53). Therefore, NMFS should evaluate the expected level of *A. cervicornis* take through transplantation, so that these levels can be included in the evaluation of whether the proposed action will jeopardize the continued existence of the species.

NMFS has previously stated:

> "…that the collection of small tissue samples from A. cervicornis colonies will result in temporary effects on coral colonies. The collection of approximately 3-cm-long branch tip tissue samples from single staghorn coral colonies will result in a small reduction of coral colony biomass; however, this effect is expected to be temporary with recovery through tissue replacement and/or coral colony growth. Acropora cervicornis' dominant mode of reproduction is through asexual fragmentation (see Section 3.2 for further discussion). In the congener Acropora palmata, lesions at the point of fragment detachment have been shown to begin regeneration within two weeks (Lirman 2000) of fragmentation, with regeneration rates being positively correlated with decreasing size of lesion and proximity to growing tip. The size of the lesion created in this project will be a function of the diameter of the branch being clipped. The diameter of staghorn coral branches ranges from 0.25 to 1.5 cm. Lirman (2000) showed that a 3-cm2 lesion regenerated completely within 100 days. Given that the rate of recovery is an exponential decay, it is expected that lesions 0.25 to 1.5 cm in diameter (less than 2.25 cm2) will recover much faster than in Lirman's experiment.
>
> Furthermore, the proposed collection of tissue samples from A. cervicornis colonies will occur at the outermost portion of the branch tip of the coral colony. Soong and Lang (1992) observed that, in A. cervicornis, large polyps and basal tissues located 1.0 to 4.5 cm from the colony base were infertile, and larger eggs were located in the mid-region of colony branches. Gonads located within 2 to 6 cm of the colony's branch tips always had smaller eggs than those in the mid-region (Soong and Lang 1992). Larger colonies (as measured by surface area of the live colony) have higher fertility rates (Soong and Lang 1992). Thus, the effect of this activity on coral colony reproduction is insignificant. Given that the collected tissue samples are small in size (~3 cm) relative to coral colony size, that the effects of collecting such fragments are temporary, that fragmentation is a natural reproductive mode, and that these fragments will be collected from the outermost portion of the coral branch tip where smaller eggs are found, it is not likely that

> survival or reproductive output of staghorn coral colonies will be measurably reduced by the proposed action.
>
> Coral transplantation can successfully relocate colonies that would likely suffer injury or morality if not moved. Provided that colonies are handled with skill, are reattached properly, and the environmental factors at the reattachment site are conducive to their growth (e.g. water quality, substrate type, etc.), many different species of coral have been shown to survive transplantation well (Maragos 1974, Birkeland et al. 1979, Harriott and Fisk 1988, Hudson and Diaz 1988, Guzman 1991, Kaly 1995, Berker and Mueller 1999, Tomlinson and Pratt 1999, Hudson 2000, Lindahl 2003, NCRI 2004). Herlan and Lirman (2008) documented a 17.3 percent mortality rate in Acropora coral fragments after transplantation to a coral nursery in Biscayne National Park. The authors stated the mortality rate might have been increased due to stress caused by relatively high water temperatures during fragmentation not necessarily the process itself. This observation has been supported by other nursery managers who report post-relocation coral fragment mortality rates closer to 1 percent (NMFS, 2009). Transplantation of coral colonies less than 10 cm in size is not feasible because detaching such small colonies would likely result in breakage. Survivability of transplanted coral colonies less than 10 cm in size is also very low due to injury and the decrease in the overall surface area of living tissue, which reduces the colony's resilience to stress." (NMFS, 2009).

We believe that unless Acroporid corals are relocated from the impact area, if they were found to be present, up to 50% could be injurious taken or lethally taken due to the impacts of anchor/cable usage associated with cutterhead dredging. These effects are detailed further in the BA under the heading "Dredging - Deepening Entrance Channel Utilizing Cutterhead Dredge". We believe coral transplantation will be highly successful and relocating these corals outside the entrance channel is appropriate to minimize the impact of this take. Similar habitat, influenced by the same environmental conditions currently affecting these colonies, exists both north and south of the entrance channel beyond the 150-m indirect impact zone, and has been documented to support *A. cerviconis* (USN, 2011; Gilliam et al, 2011). Because suitable transplantation habitat is nearby and proper handling techniques are available and will be required (see Appendix A of Miami Harbor Biological Opinion), we have confidence that transplantation survival rates similar to those noted by NMFS in the 2009 biological opinion will be likely in this case. NMFS has previously stated a maximum estimated coral fragment mortality rate of 17% (NMFS, 2009), although this may be artificially high, brought on more by unusual environmental conditions than actual transplantation. To be conservative, we use a 17% mortality rate in our estimates, but believe actual mortality may be lower. Therefore, we anticipate 100 percent success in reattachment and an 83% survival rate of transplanted colonies. These same estimates were previously utilized by NMFS (2009).

Summary Effects Determination

The Corps has determined that the proposed expansion of Port Everglades may adversely affect listed and proposed species within the action area and requests initiation of formal consultation with NMFS.

SUMMARY OF EFFECT DETERMINATIONS

Project effect determination summary for sea turtle *sp*., Johnson's seagrass, Acroporid *sp*., large whales, and smalltooth sawfish (No Effect (NE – green); May Affect Not Likely to Adversely Affect (MANLAA – orange), May Affect Likely to Adversely Affect (MALAA – yellow), and Not Likely to Adversely Modify (NLAM – orange)

Proposed Activity	**Effect Determination**													
	Sea Turtle					**Johnson's seagrass**	**Acroporid Sp.**	**Large Whales**						**Smalltooth Sawfish**
	Leatherback	***Loggerhead***	***Green***	***Kemp's Ridley***	***Hawksbill***			***NARW***	***Humpback***	***Sperm***	***Blue***	***Sei***	***Fin***	
Hydraulic Hopper limited to the channel bottom	NE	MALAA	MALAA	MALAA	MALAA	MALAA	NE	NE	NE	NE	NE	NE	NE	NE
Hydraulic Cutterhead w/unrestricted anchor/cable placement	NE	MANLAA	MANLAA	MANLAA	MANLAA	MALAA	MANLAA	NE	NE	NE	NE	NE	NE	NE
Mechanical Dredge (clamshell or back-hoe)	NE	MANLAA	MANLAA	MANLAA	MANLAA	MALAA	MANLAA	NE	NE	NE	NE	NE	NE	NE
Pre-Treatment with blasting	NE	MANLAA	MANLAA	MANLAA	MANLAA	NE	MANLAA	NE	NE	NE	NE	NE	NE	NE
Disposal - ODMDS	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Disposal – Reef Mitigation	NE	NE	NE	NE	NE	NE	MANLAA	NE	NE	NE	NE	NE	NE	NE
Transplantation of Acropora sp.	NE	NE	NE	NE	NE	NE	MALAA	NE	NE	NE	NE	NE	NE	NE
Critical Habitat	NLAM	NE	NLAM	NE	NLAM	NLAM	NLAM	NLAM	NE	NE	NE	NE	NE	NLAM

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ESA Consultation History – Port Everglades Feasibility Study
Consultation # F/SER/2002/00626

- September 8, 2001 – Request for Species List from Corps to NMFS-SERO
- March 25, 2002 – Biological Assessment from Corps to NMFS-SERO
- June 24, 2002 – Corps contacts NMFS to verify package has arrived and check on 30-day letter. Email from E. Hawk that package arrived, assigned log #F/SER/2002/00626 and assigned to Bob Hoffman. No 30-day letter ever received from NMFS.
- 2003 - Due to changes in the ship simulations for the project and potential change in impacts, Ms. Terri Jordan contacted Mr. Hoffman and asked him to set the BA aside, as a revision would be coming once the new ship simulations were complete.
- September 12, 2004-Letter from James Duck to Ms. Georgia Cranmore. Recommended Plan and included Corps' Biological Assessment.
- September 17, 2004 – Revised Biological Assessment from Corps to NMFS–SERO.
- November 17, 2004 – Corps calls to check on 30-day complete letter from NMFS. Resent consultation documents via mail and email to Mr. Hoffman since NMFS unable to locate package. Package has been reassigned to Mr. Juan Levesque.
- November 17, 2004 – Email from Mr. Levesque that package is complete. No additional information required.
- No 30-day letter received.
- No requests for additional information made.
- March 9, 2005 – Ms. Jordan emails Mr. Levesque asking for status check, since NMFS database does not show any movement on project. Mr. Lévesque responses that Mr. David Bernhart had reviewed Biological opinion and his comments are being responded to and package is headed to Office of General Counsel for review and clearance.
- May 9, 2005 – proposed listing of *Acropora palmata* and *A. cervicornis* as threatened under the ESA (70 FR 24359).

- Late May 2005 - After the listing, Ms. Jordan contacted Mr. Levesque by phone to discuss the new *Acropora* proposal and how it should be handled since the consultation was not yet complete. The Corps and NMFS agreed to incorporate existing surveys of the project area, including the baseline survey and the survey from the Broward County Shore Protection Project Resource GIS system (a series of 9 CDs with GIS data on them with mapped resources in Broward County – A copy of these CDs had been provided to NMFS as part of the ESA consultation for the Broward County shore protection project and represents the most detailed assessment of reef resources in Broward County). The Corps and NMFS agreed that no additional species specific surveys would be completed due to sufficient information already being available and a lack of funding (about 2 million dollars) to complete a survey of the action area specifically for these species.
- June 23, 2005 – the Corps emailed a determination that the Port Everglades feasibility study, may affect, but was not likely to adversely affect listed Acroporid corals near Port Everglades.
- July 7, 2005 – an email was received from Mr. Levesque that stated that the opinion “had gone to GC today”.
- July 27, 2005 – another email stating the opinion was still in review in the office of General Counsel.
- December 6, 2005 – email sent to Mr. Levesque and Mr. Bernhart requesting a status check on the biological opinion. No response received to this email. It is the Corps’ understanding that Mr. Levesque had been deployed to assist with hurricane Katrina recovery in October 2005 and that had delayed his working on the project.
- The next communication from NMFS came on March 28, 2006. Mr. Levesque asked for information on material disposal locations. The Corps provided additional details and a graphic showing the areas via email dated March 29, 2006 as this information was included in the baseline report sent in November 2004 as part of consultation package.
- May 9, 2006 – listing of *A. palmata* and *A. cervicornis* as threatened under the ESA (71 FR 26852)
- May 17, 2006 – informed that Mr. Levesque is leaving NMFS, no information available on who will be taking over file or on the status of the file that was last

noted as “in the office of General Counsel”. Numerous email and phone requests for information made to Bob Hoffman and Eric Hawk.

- June 2, 2006 – Informed by phone that Ms. Audra Livergood, NMFS Miami office will be completing the consultation.
- June 14, 2006 – Corps makes formal request for a timeline for the completion of the consultation to Mr. Bob Hoffman. Timeline not provided.
- June 21, 2006 – Met in person with Ms. Livergood at the Mineral Management Service’s Information Transfer meeting in Melbourne, Florida to discuss the biological opinion and its status. Made sure Ms. Livergood had all existing survey information in the file and clarified that the Port Everglades Reef survey that had been started in May 2006 would provide additional information on the species composition at the end of the entrance channel where the project proposes to extend the channel through the third reef. This would be considered additional information for the file – in addition to the Broward and baseline surveys previously discussed. Also discussed the northern right whale finding for the opinion and the history of northern right whales transiting through the project area.
- June 23, 2006 – After conversation with Ms. Livergood in Melbourne, email received agreeing to modify conference opinion request of June 23, 2005 to consultation request for the Acroporid corals due to delays by NMFS in completing consultation.
- July 6, 2006 – Copy of draft Port Everglades Reef Report sent to all resource agencies by email (A. Livergood included).
- July 25, 2006 – Port Everglades Reef Report results presentation meeting, Port Everglades. Written comments requested to be to Corps by August 7, 2006.
- August 11, 2006 – Email draft comments from Ms. Livergood on report recommending “an active and quantitative survey designed specifically to identify and quantify the presence and abundance of /A. palmata/ and /A. cervicornis/ should be conducted for the proposed impact areas and control sites. We request that the survey design and methodology be submitted to NMFS PRD for review and comment prior to conducting the survey.”

- August 11, 2006 – after receipt of the comments, Ms. Jordan contacted Ms. Livergood and discussed that while an additional survey would be nice to have, it was not feasible due to budget and schedule. Ms. Livergood offered to have NMFS review a database of known locations of Acroporid corals that has been developed as part of the listing process to see additional coral locations, not presented by the Broward County survey, baseline reports or the new Reef Survey.
- August 13, 2006 – Email from Ms. Livergood stating "I spoke to Jennifer Moore, and she said that NMFS cannot share the data yet that has been compiled for the Acropora GIS database. However, she suggested that I request a shapefile of the action area from you, and she can create a map with the Acropora data they have in-house. Would you mind sending me a shapefile of the action area for Port Everglades?"
- August 18, 2006-Letter from Mr. Bernhart- *Port Everglades Reef Mapping and Assessment, 06 July 2006 Preliminary Draft*. "NMFS PRD believes study is flawed".
- August 30, 2006 – Email to Ms. Livergood with action area. This later proved to be the original survey area provided to the Corps' baseline report contractor and covered a much larger area than the action being consulted on.
- September 7, 2006 – Email from Ms. Livergood with map of known *Acropora* colonies in the action area as provided on August 30, 2006. At this time, Corps realized that graphic of refined action area needed to be sent since the original covered much more area than the true action area.
- September 21, 2006 – Phone call between Ms. Jordan and Ms. Livergood – Re: Revised action area for Port Everglades
- September 21, 2006 – Email from Ms. Livergood requesting justification for change in action area.
- September 21, 2006 – Email to Ms. Livergood clarifying why the need for the change in action area.
- September 22, 2006 – Email to Ms. Livergood with new graphic showing revised action area.
- September 25, 2006 – Email from Ms. Livergood requesting shapefile of revised action area be sent to her and NMFS-St. Petersburg for database review.

- September 26, 2006 – Email to Ms. Livergood and Amanda Flick with shapefile of the revised action areas.
- October 12, 2006 – Updated seagrass report emailed to Ms. Livergood
- Oct 13, 2006 – Although effects determination provided earlier as part of request for consultation sent to Mr. Levesque for Acroporid dated June 2005 – at NMFS' request, the Corps prepared memo for the record with an effects determination for Acroporid corals. Memo sent by email.
- Oct. 18, 2006-Letter to Mr. Bernhart (NMFS) from Mrs. Marie Burns. Response to belief that "study is flawed".
- Mar 26, 2008-Letter from Mr. Bernhart to Mrs. Burns reiterating recommendations from August 18, 2006 letter. Concerned *cervicornis* may occur closer than 3,500 feet to the entrance channel.
- Apr 28, 2008- The Corps met with NMFS leadership and staff in St. Petersburg to discuss the project timeline, *Acropora* survey methodology and a path forward for the project. Determination was made that navigation channels in Designated Critical Habitat required alternative survey methodology, and Corps would work with NMFS SEFSC researchers to develop this methodology.
- Dec 2009-*Benthic and Fish Community Assessment at Port Everglades Harbor Entrance Channel Final Draft. Prepared by Dial Cordy and Associates Inc. for CORPS Jacksonville District.* Document finalized.
- Summer 2010 – Acropora survey with new navigation channel protocol conducted at Port Everglades.
- Oct 2010- *Acropora Coral Survey Final Report*. Prepared by Dial Cordy and Associates Inc. for CORPS Jacksonville District
- October 12, 2011 - Review of video and results of Survey completed with Robert Hoffman, Chief, ESA consultation branch, NMFS-SERO-PRD. Mr. Hoffman expressed satisfaction with methodology utilized and results of survey.
- August 2, 2011 – NMFS informs Corps of Navy *Acropora* survey that detected *Acropora* on Reef 3 and requests that CORPS hold off submittal of ESA consultation package until Navy report is complete. Corps requests copy of report from Navy when they are able to release report.

- Dec 2011-*Benthic Habitat Characterization for the South Florida Ocean Management Facility: Protected Stony Coral Species Assessment*. Prepared by Gilliam & Walker for Seaward Services completed for US Navy.
- February 13, 2012 – Corps receives Navy *Acropora* Survey.
- May 1, 2012 – Corps Environmental Branch leadership meets with NMFS PRD and HCD leadership to discuss ongoing projects and communication. Included in those discussions, NMFS-PRD leadership asks Corps to compile a complete package for the ESA consultation for Port Everglades and resubmit all materials in that complete package.
- May – August 2012 – Corps revised package, prepared new documentation and completed package for submittal to NMFS for continued consultation.
- August 20, 2012 – Corps informed that consultation has been reassigned to a new NMFS biologist – Kelly Logan.
- September 5, 2012 – Corp’s Supplemental Consultation package complete, letter to David Bernhart transmitting package signed by Jason Spinning.

Sept 17, 2004

Planning Division
Environmental Branch

Ms. David Bernhart
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
9721 Executive Center Drive North
St. Petersburg, Florida 33702

Dear Mr. Bernhart:

This request for consultation replaces the original request for this project submitted to your office March 25, 2002 for the port Everglades Feasibility Study.

The U.S. Army Corps of Engineers (Corps), Jacksonville District proposes to conduct a feasibility study to assess Federal interest in navigation improvements throughout Port Everglades. An evaluation of benefits, costs, and environmental impacts determines Federal interest. This Feasibility Study was authorized by a resolution of the House Committee on Transportation dated May 9, 1996.

The Recommended Plan main elements include: widening and deepening the Outer Entrance Channel to –56 feet (-54 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), deepening the Inner Entrance Channel and Main Turning Basin to –51 feet (-49 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), widening and deepening the Southport Access Channel to –51 feet (-49 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), widening of the DCC to 310 feet and deepening the Dania Cutoff Canal to –34 feet (-32 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), constructing a Turning Basin at the intersection of the Dania Cutoff Canal and the Southport Access Channel at –34 feet (-32 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), deepening a portion of the South Turning Basin to –46 feet (-44 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth), and widening and deepening the Turning Notch to –51 feet (-49 feet authorized + 1 foot required overdepth and 1 foot allowable overdepth). Other significant construction items include relocation of the U.S. Coast Guard (USCG) Basin easterly within essentially

USCG property, port facility construction, and environmental mitigation.

Enclosed please find the Corps' biological assessment of the effects of the proposed project on listed species in the action area. A copy of the Baseline Assessment prepared for this proposed project has been sent to your office previously by email to Mr. Robert Hoffman.

We request initiation of consultation under section 7 of the Endangered Species Act concerning the effects of the proposed activities on the smalltooth sawfish, green, hawksbill, Kemp's ridley, leatherback and loggerhead sea turtles, humpback and sperm whales and Johnson's seagrass.

If you have any questions, please contact Ms. Terri Jordan at 904-232-1817 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Jordan/CESAJ-PD-EA/3453/
McAdams/CESAJ-PD-EA
Dugger/CESAJ-PD-E
Scarborough/CESAJ-DP-C
Strain/CESAJ-PD-P
Duck/CESAJ-PD

L: group/pde/jordan/Version 2 Sect 7 cover letter NMFS

BIOLOGICAL ASSESSMENT
PORT EVERGLADES NAVIGATION PROJECT
BROWARD COUNTY, FLORIDA

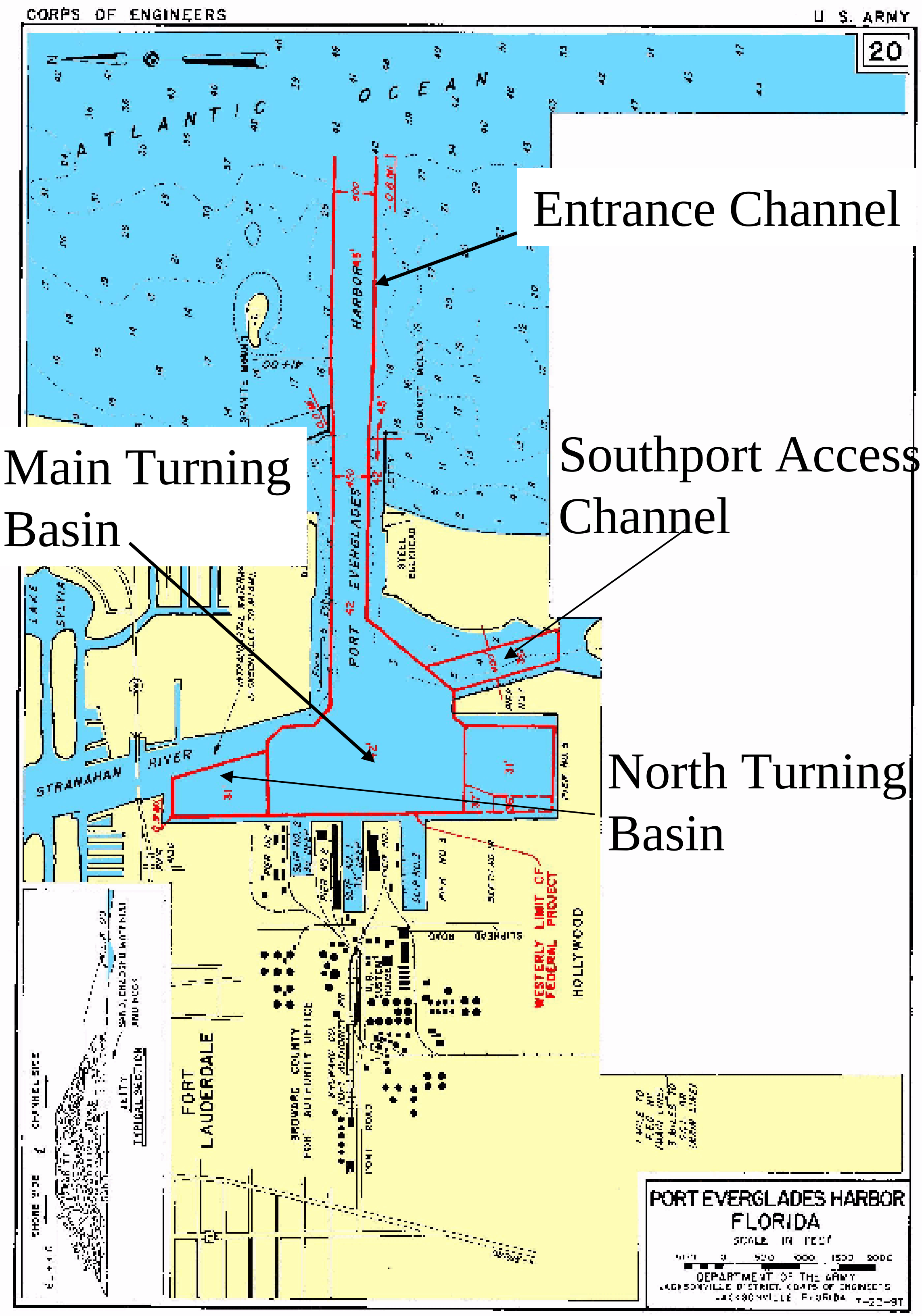
Description of the Proposed Action

The U.S. Army Corps of Engineers (Corps) proposes to expand and deepen Port Everglades Harbor. A detailed description of the proposed project and all alternatives considered under the Feasibility Study are evaluated in the pending Draft Environmental Impact Statement. Broward County Port Department requested that the Corps study the feasibility of widening and deepening most of the major channels and basins within Port Everglades. Four major improvement goals were identified. 1) Improve transit in the Outer Entrance Channel (OEC), Inner Entrance Channel (IEC), Main Turning Basin (MTB) and Southport Access Channel (SAC) to accommodate liquid bulk, cruise, and container vessels; 2) Develop the Dania Cutoff Canal (DCC) to accommodate mid-size vessels; 3) Deepen the North Turning Basin to accommodate Panamax size container ships; and 4) Improve turning and berthing in the Turning Notch (Figure 1).

The purpose of the proposed action is to provide increased safety, efficiency and lower costs for future port navigation and utilization, while protecting the environment. The proposed action resulted from a comprehensive analysis of all the existing and future commercial vessel transit needs within the port. This economic analysis has shown that improvements to most of the major Federal and non-Federal channels and basins are required to achieve efficient transit of the existing fleet, and to accommodate the future fleet. Substantial liquid bulk cargo cost savings can be achieved by deepening the OEC, IEC, and MTB. Widening of the OEC flare will allow safer transit for all the larger commercial vessels that experience sometimes troublesome cross currents at the channel entrance. Removal of the Widener Shoal and widening of the SAC allows for more efficient and safer transits of containerized cargo vessels past the Knuckles restriction where new generation cruise vessels are expected to be berthed. Lengthening and deepening of the TN will provide turning possibilities for larger vessels and will provide critical berthing for containerized cargo vessels. Deepening of the STB will allow for more efficient use Berths 16-18 by allowing Panamax vessel calls. Finally, widening and deepening of the DCC (in addition to a turning basin located adjacent to the SAC) will allow for relocation of smaller and midsize container, roll on/roll off (ro/ro) vessels, and general cargo traffic, thereby reducing congestion in the areas serviced by larger vessels.

The Corps expects the construction to be performed using a variety of methods including blasting and dredging with a cutterhead, clamshell, hopper or other type of dredge. Any blasting that will occur within the project will be confined blasting. Confined blasting is defined as a blast where the explosives had been placed in a hole bored into the rock substrate and capped with 3-4 feet of crushed rock known as “stemming”. Stemming forces the explosive blast downward into the rock instead of allowing the blast to expand into the water column.

Fig 1 – Port Everglades Federal Navigation Project



Action Area

The Port Everglades Harbor is the second largest seaport located on the east coast of Florida. The Harbor lies adjacent to cities of Dania and Fort Lauderdale (Broward County), with immediate access to the Atlantic Ocean and the Intracoastal Waterway. The entrance of the Port is approximately 27 nautical miles north of Miami Harbor, Florida and 301 nautical miles south of Jacksonville Harbor, Florida. Figure 2 shows major features located within and surrounding the project site.

Protected Species Included in this Assessment

The Corps has determined the that the following listed species under NMFS jurisdiction occur in the action area: green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*), Johnson's seagrass (*Halophila johnsonii*), blue (*Balenoptera musculus*), humpback, (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), fin (*Balenoptera physalus*) and sperm (*Physeter macrocephalus*) whales and smalltooth sawfish (*Pristis pectinata*). The Corps has relied heavily upon the Surtass LFA Biological Opinion that was completed by NMFS on May 31, 2002 for biological information concerning the biology, life history and status for the large whale species discussed in this assessment. This document was accessed from the NMFS website at:
http://www.nmfs.noaa.gov/prot_res/readingrm/ESAsec7/7pr_surtass-2020529.pdf.

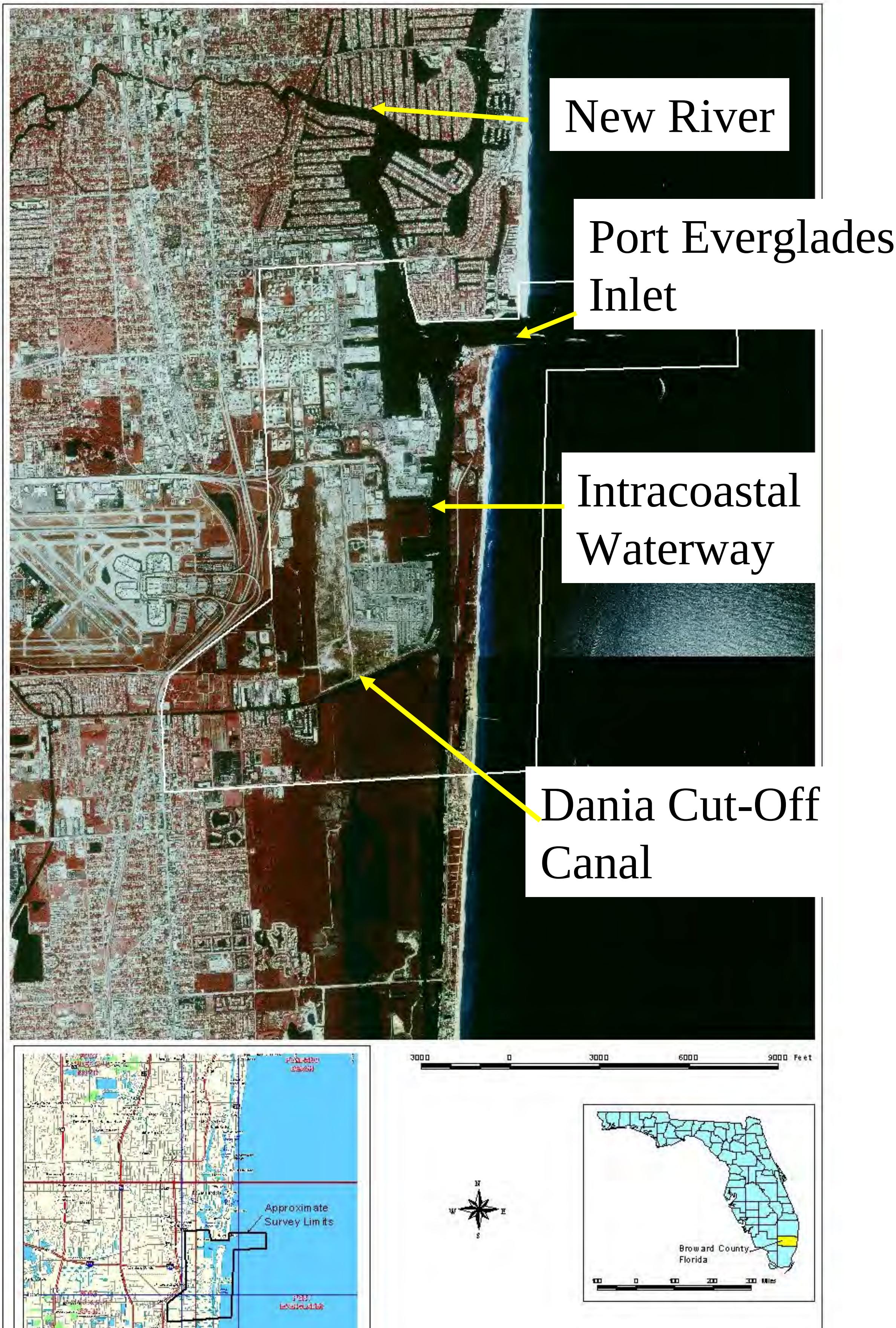
The Corps has reviewed the biological, status, threats and distribution information presented in this assessment and believes that the following species will be in or near the action area and thus may be affected by the proposed project: the five sea turtle species; humpback and sperm whales, Johnson's seagrass and smalltooth sawfish.

Six species of endangered marine mammals may be found seasonally in the waters offshore southeastern Florida. The Corps believes that only the sperm and humpback whales may be adversely affected by activities associated with the proposed action. These effects would be a result of acoustic harassment.

The blue, fin, northern right and sei whales are not discussed in detail because they are unlikely to be within the vicinity of the project. Additional information on blue, fin and sei whales can be found in Waring *et al*. (1999). Due to the rarity of sightings of these four whale species near the project area, the Corps believes that any effects to them by the project are discountable. Discountable effects under Section 7 of the ESA are those "extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur."

The endangered Florida manatee (*Trichecus manatus*) and the American crocodile (*Crocodylus acutus*) also occur with the action area and the Corps has initiated consultation with the U.S. Fish and Wildlife Service concerning the effects of the proposed action on these species.

Fig 2 – Location Map and Plan View



Status and Distribution of the Species

Green Turtle (*Chelonia mydas*)

Distribution. Green turtles are distributed circumglobally. In the western Atlantic they range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare north of Cape Hatteras (Wynne and Schwartz, 1999). Several major nesting assemblages have been identified and studied in the western Atlantic (Peters 1954; Carr and Ogren, 1960; Carr *et al.*, 1978). Most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart 1979). Green turtles are the largest of the hard-shelled sea turtles. Adult male green turtles are smaller than adult females whose lengths range from 92 to 110 cm (36 to 43 in.) and weights range from 119 to 182 kg (200 to 300 lbs). Their heads are small compared to other sea turtles and the biting edge of their lower jaws is serrated.

Green turtles have a more tropical distribution than loggerhead turtles; they are generally found in waters between the northern and southern 20^{o}C isotherms (Hirth 1971). Green turtles, like most other sea turtles, are distributed more widely in the summer when warmer water temperatures allow them to migrate north along the Atlantic coast of North America. In the summer, green turtles are found around the U.S. Virgin Islands, Puerto Rico, and continental North America from Texas to Massachusetts. Immature greens can be distributed in estuarine and coastal waters from Long Island Sound, Chesapeake Bay, and the North Carolina sounds south throughout the tropics (Musick and Limpus, 1997). In the United States, green turtles nest primarily along the Atlantic Coast of Florida, the U.S. Virgin Islands, and Puerto Rico. In the winter, as water temperatures decline, green turtles that are found north of Florida begin to migrate south into subtropical and tropical water.

Status and Population Trends. The green turtle was protected under the ESA in 1978; breeding populations off the coast of Florida and the Pacific coast of Mexico are listed as endangered, all other populations are listed as threatened. Recent population estimates for the western Atlantic area are not available. However, there is evidence that green turtle nesting has been on the increase during the past decade. Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches where most green turtle nesting activity occurs have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the six years of regular monitoring since establishment of the index beaches in 1989. A nesting summary for the county in which the proposed project resides is found in Table 1.

Table 1: Summary of Green Turtle (*Chelonia mydas*) Nesting in Broward County, 1988-2003

Year	Beach Length (km)	Number of Nests	Number of Non-Nesting Emergences	Date of First Nest	Date of Last Nest
1988	38.4	35	25	5/27/88	6/29/88
1989	42.1	30	24	6/2/89	8/17/89
1990	38.3	106	82	5/13/90	9/12/90
1991	38.6	11	25	6/12/91	9/4/91
1992	41.3	132	205	6/6/92	9/5/92

1993	42.5	31	25	6/30/93	9/3/93
1994	42.5	123	189	6/2/94	9/10/94
1995	37.4	52	97	5/12/95	9/13/95
1996	42.5	130	188	5/31/96	9/11/96
1997	42.5	29	48	5/24/97	9/10/97
1998	42.5	200	265	5/30/98	9/6/98
1999	38.6	24	32	5/24/99	9/3/99
2000	38.6	255	394	5/17/00	9/3/00
2001	38.6	26	48	3/16/01	8/4/01
2002	38.6	216	342	5/16/02	9/26/02
2003	28.6	78	49	5/30/03	9/28/03

Source: Florida Marine Research Institute. 2004

Natural History. While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Post-pelagic green turtles feed primarily on sea grasses and benthic algae but also consume jellyfish, salps, and sponges. In the western Atlantic region, the summer developmental habitat encompasses estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds, and south throughout the tropics (Musick and Limpus, 1997). Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to southern waters in autumn, or face the risk of cold stunning.

Threats. The greatest threat to this species is the loss of its nesting habitat. Throughout the tropical and subtropical distribution of this species, beaches are eroded, armored, renourished, or converted for residential or commercial purposes. Green turtles are also threatened by fibropapilloma disease; incidental takes in commercial or recreational fishing gear; and poaching (although poaching is infrequent in the United States). Green turtles are harvested in some nations for food, leather, and jewelry. Green turtles are also threatened by natural causes including hurricanes; predation by fire ants, raccoons, and opossums; and poaching of eggs and nesting females.

Anthropogenic impacts to the green turtle population are similar to those for other sea turtle species. Sea sampling coverage in the pelagic driftnet, pelagic longline, scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. In addition, the NMFS/Northeast Fisheries Science Center (NEFSC) is conducting a review of bycatch levels and patterns in all fisheries in the western Atlantic for which observer data is available. Bycatch estimates will be made for all fisheries for which sample sizes are sufficiently large to permit reasonable statistical analysis. This will be compiled into an assessment report. Until that analysis is completed, the only information on the magnitude of takes available for fisheries in the action area are unextrapolated numbers of observed takes from the sea sampling data. Preliminary sea sampling data summary (1994-1998) shows the following total take of green turtles: one (anchored gillnet), two (pelagic driftnet), and two (pelagic longline). Stranding reports indicate that between 200-300 green turtles strand annually from a variety of causes (Sea Turtle Stranding and Salvage Network, unpublished data). As with the other species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality.

Critical Habitat. In 1998, NMFS designated the waters surrounding the islands of Culebra, Puerto Rico as critical habitat for the green turtle. This area supports major seagrass beds and reefs that provide forage and shelter habitat. The action area does not comprise critical habitat for green turtles.

Loggerhead Turtle

Distribution. Loggerhead turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters. Loggerheads concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The largest known nesting aggregation of loggerhead turtles occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani, 1982). In the western Atlantic, most loggerhead turtles nest from North Carolina to Florida and along the gulf coast of Florida. The best scientific and commercial data available on the genetics of loggerhead turtles suggests there are four major subpopulations of loggerheads in the northwest Atlantic: (1) a northern nesting subpopulation that occurs from North Carolina to northeast Florida, about 29^{o} N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29^{o} N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); and (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990) (approximately 1,000 nests in 1998, according to TEWG, 2000). This biological assessment will focus on the northwest Atlantic subpopulations of loggerhead turtles, which occur in the action area. A nesting summary for the county in which the action is proposed is included in Table 2.

Table 2: Summary of Loggerhead (*Caretta caretta*) Nesting in Broward County, 1988-2003

Year	Beach Length (km)	Number of Nests	Number of Non-Nesting Emergences	Date of First Nest	Date of Last Nest
1988	38.4	1349	2509	5/1/88	8/28/88
1989	42.1	1791	1547	4/20/89	9/8/89
1990	38.3	2283	1928	4/22/90	9/12/90
1991	38.6	2033	1923	4/23/91	9/3/91
1992	41.3	2230	1978	4/23/92	9/2/92
1993	42.5	2267	2071	4/29/93	9/15/93
1994	42.5	2180	2306	4/23/94	9/4/94
1995	37.9	2567	2330	4/25/95	9/12/95
1996	38.6	2902	3235	4/23/96	9/7/96
1997	38.6	2216	2382	4/18/97	9/8/97
1998	38.6	2643	4065	4/23/98	9/13/98
1999	38.6	2584	3025	4/18/99	8/29/99
2000	38.6	2674	3121	4/18/00	9/9/00
2001	38.6	2321	2327	4/20/01	8/28/01
2002	38.6	2070	2361	4/12/02	9/10/02
2003	38.6	2335	2746	4/17/03	8/28/03

source: Florida Marine Research Institute. 2004

Although NMFS and FWS have not completed the administrative processes necessary to formally recognize populations or subpopulations of loggerhead turtles, these sea turtles are generally grouped by nesting locations. Based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG, 1998; TEWG 2000), NMFS and FWS treat these loggerhead turtle nesting aggregations as distinct subpopulations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will focus on the four nesting aggregations of loggerhead turtles identified in the preceding paragraph (which occur in the action area) and treat them as subpopulations for the purposes of this analysis. Natal homing to the nesting beach provides the genetic barrier between these subpopulations, preventing recolonization from turtles from other nesting beaches. The importance of maintaining these subpopulations in the wild is shown by the many examples of extirpated nesting assemblages in the world. In addition, recent fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco *et al.* 2000) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, LeBuff 1990, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but generally are rare (Ehrhart 1979; LeBuff 1974, 1990; CMTTP; Bjorndal *et al.* 1983: *in* NMFS SEFSC 2001).

The loggerhead turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern nesting subpopulation produces about 9% of the loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia: between 25 and 59 percent of the loggerhead turtles in this area are from the northern subpopulation (NMFS SEFSC 2001; Bass *et al*., 1998; Norrgard, 1995; Rankin-Baransky, 1997; Sears 1994, Sears *et al.*, 1995). In the Carolinas, the northern subpopulation is estimated to make up from 25% to 28% of the loggerheads (NMFS SEFSC 2001; Bass *et al.* 1998, 1999). About ten percent of the loggerhead turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell *et al*., in prep). In the Gulf of Mexico, most of the loggerhead turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10% of the loggerhead sea turtles in the Gulf (Bass pers. comm). In the Mediterranean Sea, about 45 - 47 percent of the pelagic loggerheads are from the South Florida subpopulation and about two percent are from the northern subpopulation, while only about 51% originated from Mediterranean nesting beaches (Laurent *et al.*, 1998). In the vicinity of the Azores and Madiera Archipelagoes, about 19% of the pelagic loggerheads are from the northern subpopulation, about 71% are from the South Florida subpopulation, and about 11% are from the Yucatán subpopulation (Bolten *et al*., 1998).

Natural History. Loggerhead turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years. Turtles in this life history stage are called “pelagic immatures” and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al*., in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm SCL they recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico.

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M., pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder *et al.*, 1998) along the south and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals actually are more abundant in these areas or just more abundant within the area relative to the smaller turtles. Benthic immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.*, 1995; Keinath, 1993; Morreale and Standora, 1999; Shoop and Kenney, 1992), and migrate northward in spring. Given an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer and Limpus, 1998), the benthic immature stage must be at least 10-25 years long. NMFS SEFSC 2001 analyses conclude that juvenile stages have the highest elasticity and maintaining or decreasing current sources of mortality in those stages will have the greatest impact on maintaining or increasing population growth rates.

Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, sea turtles do not usually appear on the summer foraging grounds until June, but are found in Virginia as early as April. The large majority leaves the Gulf of Maine by mid-September but may remain in these areas until as late as November and December. Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz, 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets) (NMFS and USFWS, 1991).

Adult female loggerheads in the western Atlantic come ashore to nest primarily from North Carolina southward to Florida. Additional nesting assemblages occur in the Florida Panhandle and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Threats. Loggerhead sea turtles face a number of human-related threats in the marine environment, including oil and gas exploration, development, and transportation; marine pollution; trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries (see below); underwater explosions; dredging, offshore artificial lighting; power plant entrapment; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching.

Although loggerhead turtles are most vulnerable to pelagic longlines during their pelagic, immature life history stage, there is some evidence that benthic immatures may also be captured, injured, or killed by pelagic fishery operations. Recent studies have suggested that not all loggerhead turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments. Some may not totally circumnavigate the North Atlantic. In addition, some of these turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or they may move back and forth between pelagic and coastal habitats (Witzell in prep.). Any loggerhead turtles that follow this developmental model would be adversely affected by shark gill nets and shark bottom longlines set in coastal waters, in addition to pelagic longlines.

On their nesting beaches in the U.S., loggerhead turtles are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; exotic dune and beach vegetation; predation by fire ants, raccoons, armadillos, opossums; and poaching. Elimination/control of these threats are especially important because, from a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species: it is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35 and 40 percent of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al*., 1995).

Loggerhead turtles also face numerous threats from weather and coastal processes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and loggerhead turtle nesting season (March to November); hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton *et al*., 1992). On Fisher Island near Miami, Florida, 69% of the eggs did not hatch after Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern subpopulation were destroyed by hurricanes, which made landfall in North Carolina in the mid to late 1990's. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. The recent landfall of Hurricane Charley on Florida's southwest coast and the impending landfall of Hurricane Frances will also have adverse effects on nest success. These natural phenomena probably have significant, adverse effects on the size of specific year classes; particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

Status and Population Trends. The loggerhead turtle was listed as threatened under the ESA on July 28, 1978. The most recent work updating what is known regarding status and trends of loggerhead sea turtles is contained in NMFS SEFSC 2001. The recovery plan for this species (NMFS and USFWS 1991) state that southeastern U.S. loggerheads can be considered for delisting if, over a period of 25 years, adult female populations in Florida are increasing and there is a return to pre-listing annual nest numbers totaling 12,800 for North Carolina, South Carolina, and Georgia combined. This equates to approximately 3,100 nesting females per year at 4.1 nests per female per season. NMFS SEFSC 2001 concludes, "…nesting trends indicate that the numbers of females associated with the South Florida subpopulation are increasing. Likewise, nesting trend analyses indicate potentially increasing nest numbers in the northern subpopulation" (TEWG 2000). However, NMFS SEFSC 2001 also cautions that given the uncertainties in survival rates (of the different life stages, particularly the pelagic immature stage), and the stochastic nature of populations, population trajectories should not be used now to quantitatively assess when the northern subpopulation may achieve 3,100 nesting females.

Several published reports have presented the problems facing long-lived species that delay sexual maturity in a world replete with threats from a modern, human population (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high, annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general tenet of population ecology originated in studies of sea turtles (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). Heppell *et al.* (in prep.) specifically showed that the growth of the loggerhead sea turtle population was particularly sensitive to changes in the annual survival of both juvenile and adult sea turtles and that the adverse effects of the pelagic longline fishery on loggerheads from the pelagic immature phase appeared critical to the survival and recovery of the species. Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles would adversely affect large segments of the total loggerhead sea turtle population.

The four major subpopulations of loggerhead sea turtles in the northwest Atlantic, northern, south Florida, Florida panhandle, and Yucatán are all subject to fluctuations in the number of young produced annually because of natural phenomena like hurricanes as well as human-related activities. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merrit Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. Sea turtles nesting in the southern and central counties of Florida can be affected by beach armoring, beach renourishment, beach cleaning, artificial lighting, predation, and poaching (NMFS & FWS 1991).

As discussed previously, the survival of juvenile loggerhead sea turtles is threatened by a completely different set of threats from human activity once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North Atlantic over several years (Carr 1987, Bjorndal 1994). During that period, they are exposed to a series of long-line fisheries that include an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al*., 1995, Bolten *et al.*, 1994, Crouse 1999). Based on their proportional distribution, the capture of immature loggerhead sea turtles in long-line fleets in the Azores and Madiera Archipelagoes and the Mediterranean Sea will have a significant, adverse effect on the annual survival rates of juvenile loggerhead sea turtles from the western Atlantic subpopulations, with a disproportionately large effect on the northern subpopulation that may be significant at the population level.

In waters off coastal U.S., a suite of fisheries in Federal and State waters threatens the survival of juvenile loggerhead sea turtles. Loggerhead turtles are captured, injured, or killed in shrimp fisheries off the Atlantic coast; along the southeastern Atlantic coast, loggerhead turtle populations are declining where shrimp fishing is intense off the nesting beaches (NRC 1990). Conversely these nesting populations do not appear to be declining where nearshore shrimping effort is low or absent. The management of shrimp harvest in the Gulf of Mexico demonstrates the correlation between shrimp trawling and impacts to sea turtles. Waters out to 200nm are closed to shrimp fishing off of Texas each year for approximately a three-month period (mid-May through mid-July) to allow shrimp to migrate out of estuarine waters; sea turtle strandings decline dramatically during this period (NMFS, STSSN unpublished data). Loggerhead sea turtles are captured in fixed pound-net gear in the Long Island Sound, in pound-net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, in gill net fisheries in the mid-Atlantic and elsewhere, in fisheries for monkfish and for spiny dogfish, and in northeast sink gillnet fisheries (see further discussion in the *Environmental Baseline* of this Opinion). Witzell (1999) compiled data on capture rates of loggerhead and leatherback turtles in U.S. longline fisheries in the Caribbean and northwest Atlantic; the cumulative takes of these fisheries approach those of the U.S. shrimp fishing fleet (Crouse 1999, NRC 1990).

Based on the data available, it is not possible to estimate the size of the loggerhead population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. Given this, between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016-89,034 annually, representing, on average, an adult female population of 44,780 [(nests/4.1) * 2.5]. On average, 90.7% of the nests were from the South Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle subpopulation. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation they belong. Based on the above, there are only an estimated 3,800 nesting females in the northern loggerhead subpopulation. The status of this population, based on number of loggerhead nests, has been classified as stable or declining

(TEWG 2000). Another consideration adding to the vulnerability of the northern subpopulation is that NMFS scientists estimate, using genetics data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern subpopulation produces 65% males, while the Florida subpopulation is estimated to produce 80% females (NMFS SEFSC 2001, Part I).

Critical Habitat. No critical habitat has been designated for loggerhead turtles.

Leatherback Turtle (Dermochelys coriacea)
Distribution. The leatherback is the largest living turtle. Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found throughout waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico (Ernst and Barbour 1972).

Leatherback turtles undertake the longest migrations of any other sea turtle and exhibit the broadest thermal tolerances (NMFS and USFWS 1998). Leatherback turtles are able to inhabit intensely cold waters for a prolonged period of time because leatherbacks are able to maintain body temperatures several degrees above ambient temperatures. Leatherback turtles are typically associated with continental shelf habitats and pelagic environments, and are sighted regularly in offshore waters (>328 ft). Leatherback turtles regularly occur in deep waters (>328 ft), and an aerial survey study in the north Atlantic Ocean sighted leatherback turtles in water depths ranging from 3 to 13,618 ft, with a median sighting depth of 131.6 ft (CeTAP 1982). This same study found leatherbacks in waters ranging from 7 to 27.2°C.

Natural History. Although leatherbacks are a long lived species (> 30 years), they are somewhat faster to mature than loggerheads, with an estimated age at sexual maturity reported as about 13-14 years for females, and an estimated minimum age at sexual maturity of 5-6 years, with 9 years reported as a likely minimum (Zug and Parham 1996).

Leatherback sea turtles are predominantly distributed pelagically where they feed on jellyfish such as *Stomolophus, Chryaora,* and *Aurelia* (Rebel 1974). Leatherbacks are deep divers, with recorded dives to depths in excess of 1000 m, but they may come into shallow waters if there is an abundance of jellyfish nearshore. They also occur annually in places such as Cape Cod and Narragansett bays during certain times of the year, particularly the fall.

Status and Threats. The leatherback was listed as endangered on June 2, 1970 and a recovery plan was issued in 1998. Leatherback turtles are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, which effectively bans trade.

Globally, leatherback turtle populations have been decimated worldwide. The global leatherback turtle population was estimated to number approximately 115,000 adult females in 1980 (Pritchard 1982), but only 34,500 in 1995 (Spotila *et al*. 1996). The decline can be attributed to many factors including fisheries as well as intense exploitation of the eggs (Ross 1979). On some beaches nearly 100% of the eggs laid have been harvested (Eckert 1996). Eckert (1996) and Spotila *et al*. (1996) record that adult mortality has also increased significantly, particularly as a result of driftnet and longline fisheries.

The status of the Atlantic population is not clear. In 1996, it was reported to be stable, at best (Spotila 1996), but numbers in the Western Atlantic at that writing were reported to be on the order of 18,800 nesting females. According to Spotila (pers. com.), the Western Atlantic population currently numbers about 15,000 nesting females, whereas current estimates for the Caribbean (4,000) and the Eastern Atlantic (i.e. off Africa, numbering ~ 4,700) have remained consistent with numbers reported by Spotila *et al*. in 1996. Between 1989 and 1995, marked leatherback returns to the nesting beach at St. Croix averaged only 48.5%, but that the overall nesting population grew (McDonald, et. al 1993). This is in contrast to a Pacific nesting beach at Playa Grande, Costa Rica, where only 11.9% of turtles tagged in 1993-94 and 19.0% of turtles tagged in 1994-95 returned to nest over the next five years. Characterizations of this population suggest that it has a very low likelihood of survival and recovery in the wild under current conditions.

Spotila *et al*. (1996) describe a hypothetical life table model based on estimated ages of sexual maturity at both ends of the species= natural range (5 and 15 years). The model concluded that leatherbacks maturing in 5 years would exhibit much greater population fluctuations in response to external factors than would turtles that mature in 15 years. Furthermore, the simulations indicated that leatherbacks could maintain a stable population only if both juvenile and adult survivorship remained high, and that if other life history stages (i.e. egg, hatchling, and juvenile) remained static, stable leatherback populations could not withstand an increase in adult mortality above natural background levels without decreasing.

The primary threats to leatherback turtles are entanglement in fishing gear (e.g., gillnets, longlines, lobster pots, weirs), boat collisions, and ingestion of marine debris (NMFS and USFWS 1997). The foremost threat is the number of leatherback turtles killed or injured in fisheries. Spotila (2000) states that a conservative estimate of annual leatherback fishery-related mortality (from longlines, trawls and gillnets) in the Pacific during the 1990s is 1,500 animals. He estimates that this represented about a 23% mortality rate (or 33% if most mortality was focused on the East Pacific population). As noted above, leatherbacks normally live at least 30 years, usually maturing at about 12-13 years. Such long-lived species cannot withstand such high rates of anthropogenic mortality.

Table 3: Summary of Leatherback (*Dermochelys coriacea*) Nesting in Broward County, 1988-2003

Year	Beach Length (km)	Number of Nests	Number of Non-Nesting Emergences	Date of First Nest	Date of Last Nest
1988	38.4	4	0	5/12/88	6/1/88
1989	42.1	4	2	4/24/89	5/19/89
1990	38.3	1	2	5/9/90	5/9/90
1991	38.6	4	1	4/1/91	5/28/91
1992	41.3	7	6	4/15/92	6/16/92
1993	42.5	17	4	4/6/93	6/19/93
1994	42.5	9	0	3/24/94	5/28/94
1995	37.9	15	5	3/16/95	6/29/95
1996	38.6	2	0	5/8/96	6/3/96
1997	38.6	41	10	2/28/97	6/19/97
1998	38.6	14	8	4/26/98	6/11/98
1999	38.6	12	2	3/11/99	5/26/99

2000	38.6	13	4	5/5/00	6/3/00
2001	38.6	39	7	4/20/01	8/21/01
2002	38.6	18	7	3/2/02	6/22/02
2003	38.6	12	3	3/19/03	5/10/03

source: Florida Marine Research Institute. 2004

Critical Habitat. NMFS and FWS designated certain areas of the US Virgin Islands as critical habitat for the leatherback turtle. The action area does not comprise designated critical habitat for the species.

Hawksbill Turtle

Distribution. Hawksbill turtles occur in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Recognized subspecies occupy the Atlantic Ocean (ssp. *imbricata*) and the Pacific Ocean (ssp. *squamata*). Richardson *et al*. (1989) estimated that the Caribbean and Atlantic portions of the U.S. support a minimum of 650 hawksbill turtle nests each year. In the United States, hawksbill turtles have been recorded in all states along the Gulf of Mexico and along the Atlantic coast from Florida to Massachusetts. United States populations nest primarily in the U.S. Virgin Islands and Puerto Rico, but occasionally on the Atlantic coast of Florida. Two hawksbill turtle carcasses have been found in the vicinity of the action area (Wendy Teas, pers com, 2002, NMFS - SEFSC Miami Laboratory).

Natural History. Hawksbill turtles use different habitats for different stages in their life cycles. Post-hatchling hawksbill turtles remain in pelagic environments to take shelter in weedlines that accumulate at convergence points. Juvenile hawksbill turtles (those with carapace lengths of 20-25 cm) re-enter coastal waters where they become residents of coral reefs, which provide sponges for food and ledges, and caves for shelter. Hawksbill turtles are also found around rocky outcrops, high-energy shoals, and mangrove-fringed bays and estuaries (particularly in areas where coral reefs do not occur). Hawksbill turtles remain in coastal waters when they become subadults and adults.

Status and Threats. The hawksbill turtle was listed as an endangered species on June 2, 1970 (35 FR 8491). Populations are threatened by significant modifications of its coastal habitat throughout its range. The National Research Council (1990), and NMFS/FWS (1993) have published general overviews of the effects of habitat alteration on hawksbill turtles. In the U.S. Virgin Islands, problems such as egg poaching, domestic animals, beach driving, litter, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition, beachfront lights appear to pose a serious problem for hatchling hawksbill (and other) turtles in the U.S. Virgin Islands. At sea, activities that damage coral reefs and other habitats that are important to the hawksbill turtle threaten the continued existence of this species. Hawksbill turtles are also threatened by stochastic events (e.g., hurricanes); predation by fire ants, raccoons and opossums; and by poaching of eggs and nesting females by humans.

Critical Habitat. In 1998, NMFS designated the waters surrounding Mona and Monito Islands, Puerto Rico as critical habitat for the hawksbill turtle. The action area does not comprise designated critical habitat for the species.

Kemp's Ridley Sea Turtle

Status and Population Trends. Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempi*) (USFWS and NMFS 1992) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as *arribadas*. The primary arribada in the Gulf of Mexico is at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing.

After unprecedented numbers of Kemp's ridley carcasses were reported from Texas and Louisiana beaches during periods of high levels of shrimping effort, NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG) to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998).

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service (FWS) and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the introduction of turtle excluder devices (TEDs). Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1,940 nests in 1995 and about 3,400 nests in 1999.

The TEWG (1998) was unable to estimate the total population size and current mortality rates for the Kemp's ridley population. However, the TEWG listed a number of preliminary conclusions. The TEWG indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985. This trajectory of adult abundance tracks with trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model in the TEWG projected that Kemp’s ridleys could reach the intermediate recovery goal identified in the Recovery Plan of 10,000 nesters by the year 2020 if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the Atlantic.

The TEWG (1998) identified an average Kemp’s ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level has been much higher and decreased in 1999. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular inter-nesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

Hurricane Gilbert expanded the area surveyed for ridley nests in Mexico in 1990 due to destruction of the primary nesting beach. The TEWG (1998) assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by TEWG, trends in Kemp’s ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp’s Ridley Recovery Plan.

Natural History. Juvenile Kemp’s ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Post-pelagic ridleys feed primarily on crabs, consuming a variety of species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal, 1997). Juvenile ridleys migrate south as water temperatures cool in fall, and are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months. Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 centimeters in carapace length, and weighing less than 20 kilograms (Klinger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June, and migrating to more southerly waters from September to November (Keinath *et al.*, 1987; Musick and Limpus, 1997). In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick, 1985; Bellmund *et al.*, 1987; Keinath *et al.*, 1987; Musick and Limpus, 1997). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus, 1997).

Research being conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, Galveston NMFS Laboratory staff tracked 50 of these turtles using satellite and radio telemetry. The tracking study was designed to characterize sea turtle habitat and to identify small and large-scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NMFS Galveston Laboratory, pers. comm.).

Threats. Observations in the northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. As with loggerheads, a large number of Kemp's ridleys are taken in the southeast shrimp fishery each year. Kemp's ridleys were also affected by the apparent large-mesh gillnet interaction that occurred in spring off of North Carolina. A total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 277 loggerhead carcasses were found. This is expected to be a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all carcasses washed ashore. Stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters as well (TEWG 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana have been incidentally taken in the shrimp fishery, other sources of mortality, such as those observed in the northeastern and southeastern Atlantic zones, exist in these waters.

Critical Habitat. No critical habitat has been designated for the Kemp's ridley turtle.

Smalltooth Sawfish
All modern sawfish belong to the Suborder Pristoidea, Family Pristidae, and Genus *Pristis*. Although they are rays, sawfish appear to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. The snout of all sawfish is extended as a long narrow flattened rostral blade with a series of transverse teeth along either edge, hence the vernacular name. Species in the genus *Pristis* are separable into two groups according to whether the caudal fin has a distinct lower lobe or not. The smalltooth sawfish, *Pristis pectinata*, is the sole known representative on the western side of the Atlantic of the group lacking a defined lower caudal lobe (NMFS, 2000).

Distribution. The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In U.S. waters, *P. pectinata* historically occurred from North Carolina south through the Gulf of Mexico, where it was sympatric with the largetooth sawfish (west and south of Port Arthur, TX) (Adams and Wilson, 1995). It also was an occasional visitor to waters as far north as New York. As with all sawfishes, it is euryhaline, occurring in fresh water, nearshore estuaries and in coastal waters to depths of 25 meters.

Pristis pectinata is the largest of the sawfishes, reported to reach 760 cm while more commonly growing to 550 cm (Last and Stevens 1994). Bigelow and Schroeder (1953) reported litter size of 15-20 embryos. Overall, life history parameters for this species are largely unknown.

In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters. Records indicate that smalltooth sawfish have been found in the lower reaches of the St. Johns River and the Indian River lagoonal system. Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months.

Updated collection records from the Florida Museum of Natural History of the University of Florida include 13 records of *P. pectinata* from 1912 to 1998 (with one record not dated). Nine of these specimens were recorded from the Gulf of Mexico off Florida, three came from the Atlantic side of Florida, and one animal was caught in Pacific waters off Ecuador. Three additional records of smalltooth sawfish from the Atlantic coast of Florida have yet to be cataloged in this collection: one specimen is from 1979; the second is not dated (the Museum received both these fish from the Harbor Branch Oceanographic Institute); a third specimen was landed May 22, 1998 from the Indian River (Burgess, pers. comm.). There are eight reports of smalltooth sawfish along the Florida east coast in the 1990's, most from coastal rather than lagoonal areas.

General Human-related impacts. The principal habitats for smalltooth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder, 1953). The continued urbanization of the southeastern coastal states has resulted in substantial loss of coastal habitat through such activities as agricultural and urban development; commercial activities; dredge and fill operations; boating; erosion and diversions of freshwater run-off (SAFMC, 1998). Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. With the K-selected life history strategy of smalltooth sawfish, including slow growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary for the eventual recovery of the species.

A complete review of the factors contributing to the decline of the smalltooth sawfish can be found in the "Status Review of Smalltooth Sawfish (*Pristis pectinata*)", (NMFS, 2000) and will not be repeated in detail here.

Status and Trends. The smalltooth sawfish was added to the list of species as candidates under the ESA in 1991, removed in 1997, and placed back on the list again in 1999. In November 1999, NMFS received a petition from the Center of Marine Conservation requesting that this species be listed as endangered under the ESA. NMFS completed a status review for smalltooth sawfish in December 2000, and published a proposed rule to list this the U.S. population of this species as endangered under the ESA on April 16, 2001. On April 1, 2003, the National Marine Fisheries Service (NOAA Fisheries) announced its final determination to list smalltooth sawfish as an endangered species under the Endangered Species Act (ESA).

According to NMFS (2000) "The U.S. DPS of smalltooth sawfish has experienced a ninety percent curtailment of its range and severe declines in abundance. Agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off have resulted in the destruction and modification of smalltooth habitat throughout the southeastern U.S. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor. Over 50% of the U.S. human population lives within fifty miles of the ocean or Great Lakes. Migration to the coastlines for home, livelihood or recreation is predicted to increase by the year 2010 (National Ocean Service, 2000). Increases in coastal human populations will likely result in additional losses of marine habitats and increased pollution, further threatening the survival of smalltooth sawfish."

Simpfendorfer (2000) used a demographic approach to estimate intrinsic rate of natural increase and population doubling time. Since there are very limited life history data for smalltooth sawfish, much of the data (e.g. reproductive periodicity, longevity and age-at-maturity) were inferred from the more well-known largetooth sawfish. The litter size of smalltooth sawfish in the literature is given as 15 – 20 and Simpfendorfer used a mean of 17.5. However, the data on which this litter size is based are somewhat dubious. To account for uncertainty in the life-history parameters several different scenarios were tested, covering longevities from 30 to 70 years and ages-at-maturity from 10 to 27 years. The results indicated that the intrinsic rate of population increase ranged from 0.08/year to 0.13/ year, and population-doubling times ranged from 5.4 years to 8.5 years. These models assume the literature value for litter size is correct; doubling times would be longer if litter sizes are more in the range observed for largetooth sawfish (1 to 13, with a mean of 7.3). Simpfendorfer concluded:

> The estimated population doubling times for smalltooth sawfish indicate that the recovery times for this population will be very long. There are no data available on the size of the remaining populations, but anecdotal information indicates that smalltooth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. Fragmenting of the population will increase the time that it takes for recovery since the demographic models used in the study above assume a single inter-breeding population. The genetic effects of recovery from very small population sizes may also impact conservation efforts. It is likely that even if an effective conservation plan can be introduced in the near future, recovery to a level where the risk of extinction is low will take decades, while recovery to pre-European settlement levels would probably take several centuries.

Johnson's Seagrass

Species Description. Johnson's seagrass was listed as threatened under the ESA on September 14, 1998 based on the results of fieldwork and a status review initiated in 1990 and is the first marine plant ever listed. Kenworthy (1993, 1997, 1999) discusses the results of the field studies and summarizes an extensive literature review and associated interviews regarding the status of Johnson's seagrass.

The species has only been found growing along approximately 200 km of coastline in southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne. This narrow range and apparent endemism indicates that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy 1997). Kenworthy suggested that horizontal spreading rapid growth pattern and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms *H. johnsonii's* limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay. Surveys conducted by NMFS and Florida staff in Biscayne Bay, Florida Bay, the Florida Keys, outer Florida Bay, Puerto Rico, and the Virgin Islands provided no verifiable sightings of Johnson's seagrass outside of the range already reported.

Extent of critical habitat. The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. These limits to the species' range have been designated as critical habitat for Johnson's seagrass. Within its range, Johnson's seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. There is no designated critical habitat within the action area.

Life History

Reproductive strategy

The species is perennial and may spread even during winter months under favorable conditions (Virnstein *et al.* 1997). Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds either in the field or under laboratory conditions (Jewett-Smith *et al.* 1997). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting that the species does not reproduce sexually or that the male flowers are difficult to observer or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean, suggesting that inlet conditions are qualitatively better for flowering than conditions further inshore (Kenworthy pers. comm. 1998). It is possible that male flowers, if they exist, occur near inlets as well. Maintenance of good water quality around inlets may be essential for promoting flowering in the Johnson's seagrass population.

Niche

The essential features of habitat appear to be adequate water quality, salinity, water clarity and stable sediments free from physical disturbance. Important habitat characteristics include shallow intertidal as well as deeper subtidal zones (2-5 m). Water transparency appears to be critical for Johnson's seagrass, limiting its distribution at depth to areas of suitable optical water quality (Kenworthy 1997). In areas in which long-term poor water and sediment quality have existed until recently, such as Lake Worth Lagoon, *H. johnsonii* appears to occur in relatively higher abundance perhaps due to the previous inability of the larger species to thrive. These studies support unconfirmed previous observations that suspended solids and tannin, which reduce light penetration and water clarity, may be important factors limiting seagrass distribution. Good water clarity is essential for *Halophila johnsonii* growth in deeper waters.

Johnson's seagrass occurs over varied depths, environmental conditions, salinities, and water quality. In tidal channels *H. johnsonii* is found in coarse sand substrates, although it has been found growing on sandy shoals, in soft mud near canals and rivers where salinity many fluctuate widely (Virnstein *et al.* 1997). Virnstein has called Johnson's seagrass a "perennial opportunistic species." Within his study areas in the Indian River Lagoon, *H. johnsonii* was found by itself, with other seagrass species, in the intertidal, and (more commonly) at the deep edge of some transects in water depths of up to 180 cm. *H. johnsonii* was found shallowly rooted on sandy shoals, in soft mud, near the mouths of canals, rivers and in shallow and deep water (Virnstein *et al.* 1997). Additionally, recent studies have documented large patches of Johnson's seagrass on flood deltas just inside Sebastian Inlet, as well as far from the influence of inlets (reported at the workshop discussed in Kenworthy, 1997). These sites encompass a wide variety of salinities, water quality, and substrates.

<u>Competitors:</u>
Halophila johnsonii appears to be outcompeted in ideal seagrass habitats where environmental conditions permit the larger species to thrive (Virnstein *et al.* 1997, Kenworthy 1997).

Population Dynamics
<u>Population stability</u>
A factor leading to the listing of *H. johnsonii* is its rareness within its extremely restricted geographic range. Johnson's seagrass is characterized by small size (it is the smallest of all of the seagrasses found within its range, averaging about 3 cm in height), fragile rhizome structure and associated high turnover rate, and is apparently reliant on vegetative means to reproduce, grow and migrate across the sea bottom. These factors make Johnson's seagrass extremely vulnerable to human or environmental impacts by reducing its capacity to repopulate an area once removed. The species and its habitat are impacted by human-related activities throughout the length its range, including bridge construction and dredging, and the species' threatened status produces new and unique challenges for the management of shallow submerged lands. Vessel traffic resulting in propeller and anchor damage, maintenance dredging, dock and marine construction, water pollution, and land use practices could require special management within critical habitat.

<u>Population (genetic) variability</u>:
The Boca Raton and Boynton Beach sites proposed for critical habitat designation have populations that are distinguished by a higher index of genetic variation than any of the central and northern populations examined to date (Kenworthy, 1999). These two sites represent a genetically semi-isolated group that could be the reservoir of a large part of the overall genetic variation found in the species. Information is still lacking on the geographic extent of this genetic variability.

Status and Distribution. Kenworthy (1997, 1999) summarized the newest information on

Johnson’s seagrass biology, distribution, and abundance and confirmed the limited range and rareness of this species within its range. Additionally, the apparent restriction of propagation through vegetative means suggests that colonization between broadly disjunct areas is likely difficult, suggesting that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means. Human impacts to Johnson’s seagrass and its habitat include: (1) Vessel traffic and the resulting propeller dredging and anchor mooring; (2) dredging; (3) dock and marina construction and shading from these structures; (4) water pollution; and (5) land use practices including shoreline development, agriculture, and aquaculture.

Activities associated with recreational boat traffic account for the majority of human use associated with the proposed critical habitat areas. The destruction of the benthic community due to boating activities, propeller dredging, anchor mooring, and dock and marina construction was observed at all sites during a study by NMFS from 1990 to 1992. These activities severely disrupt the benthic habitat, breaching root systems, severing rhizomes, and significantly reducing the viability of the seagrass community. Propeller dredging and anchor mooring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity. Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat. Populations of Johnson's seagrass inhabiting shallow water and water close to inlets, where vessel traffic is concentrated, will be most affected.

The constant sedimentation patterns in and around inlets require frequent maintenance dredging, which could either directly remove essential seagrass habitat or indirectly affect it by redistributing sediments, burying plants and destabilizing the bottom structure. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson’s seagrass and its habitat through direct removal of the plant, fragmentation of habitat, and shading. Docking facilities that, upon meeting certain provisions, are exempt from state permitting also contribute to loss of Johnson’s seagrass through construction impacts and shading. Fixed add-ons to exempt docks (such as finger piers, floating docks, or boat lifts) have recently been documented as an additional source of seagrass loss due to shading (Smith and Mezich, 1999).

Decreased water transparency caused by suspended sediments, water color, and chlorophylls could have significant detrimental effects on the distribution and abundance of the deeper water populations of Johnson's seagrass. A distribution survey in Hobe and Jupiter Sounds indicates that the abundance of this seagrass diminishes in the more turbid interior portion of the lagoon where reduced light limits photosynthesis.

Other areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly attenuating shorter wavelengths of Photosynthetically Active Radiation.

Continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient overenrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulates increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A wide range of activities funded, authorized or carried out by Federal agencies may affect the essential habitat requirements of Johnson's seagrass. These include authorization by the COE for beach nourishment, dredging, and related activities including construction of docks and marinas; bridge construction projects funded by the Federal Highway Administration; actions by the U.S. Environmental Protection Agency and the COE to manage freshwater discharges into waterways; regulation of vessel traffic by the U.S. Coast Guard; management of national refuges and protected species by the U.S. Fish and Wildlife Service; management of vessel traffic (and other activities) by the U.S. Navy; authorization of state coastal zone management plans by NOAA's National Ocean Service, and management of commercial fishing and protected species by NMFS.

<u>Rangewide trend</u>:
Lamentably, there is currently insufficient information to clearly determine trends in the Johnson’s seagrass population, which was described in 1980 and has only been extensively studied during the 1990s. Generally, seagrasses within the range of Johnson’s seagrass have declined in some areas and increased in others. Where multiyear mapping studies have been conducted within the Indian River Lagoon, recent increases in Johnson’s seagrass have been noted but may be attributed in part to the recent increase in search effort and increased familiarity with this species (Virnstein *et al.* 1997). The authors conclude that from 1994 through 1997, no strong seasonal distribution or increases or decreases in abundance or range can be discerned.

Humpback Whale (Balaenoptera physalus)
Species description and distribution. Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. Humpback whales feed on krill and small schooling fish on their summer grounds. The whales occupy tropical areas during winter months when they are breeding and calving, and polar areas during the spring, summer, and fall, when they are feeding, primarily on small schooling fish and krill (Caldwell and Caldwell 1983).

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. This area will not be affected because it is within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast. Humpback whales also use the mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle *et al.*

1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill.

Life History. Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Annual pregnancy rates have been estimated at about 0.40-0.42 (NMFS unpublished and Nishiwaki 1959). Cows will nurse their calves for up to 12 months. The age distribution of the humpback whale population is unknown, but the portion of calves in various populations has been estimated at about 4B12% (Chittleborough 1965, Whitehead 1982, Bauer 1986, Herman *et al.* 1980, and Clapham and Mayo 1987).

The information available does not identify natural causes of death among humpback whales or their number and frequency over time, but potential causes of natural mortality are believed to include parasites, disease, predation (killer whales, false killer whales, and sharks), biotoxins, and entrapment in ice.

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes, euphausiids, and other large zooplankton. Fish prey in the North Pacific include herring, anchovy, capelin, pollack, Atka mackerel, eulachon, sand lance, pollack, Pacific cod, saffron cod, arctic cod, juvenile salmon, and rockfish. In the waters west of the Attu Islands and south of Amchitka Island, Atka mackerel were preferred prey of humpback whales (Nemoto 1957). Invertebrate prey includes euphausiids, mysids, amphipods, shrimps, and copepods.

Diving and social behavior. In Hawaiian waters, humpback whales remain almost exclusively within the 1820 m isobath and usually within 182 m. Maximum diving depths are approximately 150 m (492 ft) (but usually <60 m [197 ft]), with a very deep dive (240 m [787 ft]) recorded off Bermuda (Hamilton *et al.* 1997). They may remain submerged for up to 21 min (Dolphin 1987). Dives on feeding grounds ranged from 2.1-5.1 min in the north Atlantic (Goodyear unpubl. manus.). In southeast Alaska average dive times were 2.8 min for feeding whales, 3.0min for non-feeding whales, and 4.3 min for resting whales (Dolphin 1987). In the Gulf of California humpback whale dive times averaged 3.5 min (Strong 1989). Because most humpback prey is likely found above 300 m depths most humpback dives are probably relatively shallow.

Clapham (1986) reviewed the social behavior of humpback whales. They form small stable groups during the breeding season. During the feeding season they form small groups that occasionally aggregate on concentrations of food. Feeding groups are sometimes stable for long periods of times. There is good evidence of some territoriality on feeding grounds (Clapham 1994, 1996), and on wintering ground (Tyack 1981). On the breeding grounds males sing long complex songs directed towards females, other males or both. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996). Intermale competition for proximity to females can be intense as expected by the sex ratio on the breeding grounds that may be as high as 2.4:1.

Vocalizations and hearing. Humpbacks produce a wide variety of sounds. During the breeding season males sing long, complex songs, with frequencies in the 25-5000 Hz range and intensities as high as 181 dB (Payne 1970; Winn *et al.* 1970a; Thompson *et al.* 1986). Source levels average 155 dB and range from 144 to 174 dB (Thompson *et al.* 1979). The songs appear to have an effective range of approximately six to 12 miles (10 to 20 km). Animals in mating groups produce a variety of sounds (Tyack 1981; Tyack and Whitehead 1983, Silber 1986). Sounds are produced less frequently on the summer feeding grounds. Feeding groups produce distinctive sounds ranging from 20 Hz to 2 kHz, with median durations of 0.2-0.8 sec and source levels of 175-192 dB (Thompson *et al.* 1986). These sounds are attractive and appear to rally animals to the feeding activity (D=Vincent *et al.* 1985; Sharpe and Dill 1997). In summary, humpback whales produce at least three kinds of sounds: 1) complex songs with components ranging from at least 20Hz B 4 kHz with estimated source levels from 144 B 174 dB, which are mostly sung by males on the breeding grounds (Payne 1970; Winn *et al.* 1970a; Richardson *et al.* 1995); 2) social sounds in the breeding areas that extend from 50Hz B more than 10 kHz with most energy below 3kHz (Tyack and Whitehead 1983, Richardson *et al.* 1995); and 3) Feeding area vocalizations that are less frequent, but tend to be 20Hz B 2 kHz with estimated sources levels in excess of 175 dB re 1 μPa-m (Thompson *et al.* 1986; Richardson *et al.* 1995). Sounds often associated with possible aggressive behavior by males (Tyack 1983; Silber 1986) are quite different from songs, extending from 50 Hz to 10 kHz (or higher), with most energy in components below 3 kHz. These sounds appear to have an effective range of up to 9 km (Tyack and Whitehead 1983). A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. Humpback whales respond to low frequency sound. Humpback whales have been known to react to low frequency industrial noises at estimated received levels of 115 B 124 dB (Malme *et al.* 1985), and to conspecific calls at received levels as low as 102dB (Frankel *et al.* 1995). Humpback whales apparently reacted to 3.1 B 3.6 kHz sonar by changing behavior (Maybaum 1990 1993). Malme *et al.* (1985) found no clear response to playbacks of drill ship and oil production platform noises at received levels up to 116dB re 1 μPa. Studies of reactions to airgun noises were inconclusive (Malme *et al.* 1985). Humpback whales on the breeding grounds did not stop singing in response to underwater explosions (Payne and McVay 1971). Humpback whales on feeding grounds did not alter short-term behavior or distribution in response to explosions with received levels of about 150dB re 1 μPa/Hz at 350Hz (Lien *et al.* 1993; Todd *et al.* 1996). However, at least two individuals were likely killed by the high intensity, impulsed blasts and had extensive mechanical injuries in their ears (Ketten *et al.* 1993; Todd *et al.* 1996). The explosions may also have increased the number of humpback whales entangled in fishing nets (Todd *et al.* 1996). Frankel and Clark (1998) showed that breeding humpbacks showed only a slight statistical reaction to playback of 60 B 90 Hz bounds with a received level of up to 190 dB. While these studies have shown short-term behavioral reactions to boat traffic and playbacks of industrial noise, the potential for habituation, and thus the long term effects of these disturbances are not known.

Status and Trends. Humpback whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for the species.

New information has become available on the status and trends of the humpback whale population in the North Atlantic (NMFS, 2001). Although current and maximum net productivity rates are unknown at this time, the population is apparently increasing. It has not yet been determined whether this increase is uniform across all six feeding stocks (Waring *et al. in prep.*). Katona and Beard (1990) estimated the rate of increase at 9.0 percent, while Barlow and Clapham (1997) reported a 6.5 percent rate for the Gulf of Maine using data through 1991. The rate reported by Barlow and Clapham (1997) may roughly approximate the rate of increase for the portion of the population within the action area. The best estimate of abundance for the North Atlantic humpback whale population is 10,600 animals (CV=0.067; Smith *et al.* 1999), while the minimum population estimate used for NMFS management purposes is 10,019 animals (CV = 0.067; Waring *et al. in prep.*). The Northeast Fisheries Science Center is considering recommending that NMFS identify the Gulf of Maine feeding stock as the management stock for this population in U.S. waters. A population estimate for the Gulf of Maine portion of the population is not available.

Threats. In the 1990s, no more than 3 humpback whales were killed annually in U.S. waters by commercial fishing operations in the Atlantic and Pacific Oceans. Between 1990 and 1997, no humpback whale deaths have been attributed to interactions with groundfish trawl, longline and pot fisheries in the Bering Sea, Aleutian Islands, and Gulf of Alaska (Hill and DeMaster 1999). Humpback whales have been injured or killed elsewhere along the mainland U.S. and Hawaii (Barlow *et al.* 1997). In 1991, a humpback whale was observed entangled in longline gear and released alive (Hill *et al.* 1997). In 1995, a humpback whale in Maui waters was found trailing numerous lines (not fishery-related) and entangled in mooring lines. The whale was successfully released, but subsequently stranded and was attacked and killed by tiger sharks in the surf zone.

Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989, Clapham *et al.* 1993, Atkins and Swartz 1989). Their responses to noise are variable and have been correlated with the size, composition, and behavior of the whales when the noises occurred (Herman *et al.* 1980, Watkins *et al.* 1981, Krieger and Wing 1986). Several investigators have suggested that noise may have caused humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979b, Dean *et al.* 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise. Still other researchers suggest that humpback whales may become more vulnerable to vessel strikes once they habituate to vessel traffic (Swingle *et al.* 1993; Wiley *et al.* 1995).

Many humpback whales are killed by ship strikes along both coasts of the U.S. On the Atlantic coast, 6 out of 20 humpback whales stranded along the mid-Atlantic coast showed signs of major ship strike injuries (Wiley *et al.* 1995). Almost no information is available on the number of humpback whales killed or seriously injured by ship strikes outside of U.S. waters.

Sperm Whale (Physeter macrocephalus)

Species description and distribution. Sperm whales are distributed in the entire world's oceans. Sperm whales have a strong preference for the 3,280 ft (1,000 m) depth contour and seaward. Berzin (1971) reported that they are restricted to waters deeper than 300 m (984 ft), while Watkins (1977) and Reeves and Whitehead (1997) reported that they are usually not found in waters less than 3,281 ft (1,000m) deep. While deep water is their typical habitat, sperm whales have been observed near Long Island, NY, in waters of 41-55 m (135-180 ft) (Scott and Sadove

1997). When found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956). They can dive to depths of at least 2000 m (6562 ft), and may remain submerged for an hour or more (Watkins *et al.* 1993). Sperm whales feed primarily on buoyant, relatively slow-moving squid (Clark *et al.* 1993), but may also eat a variety of fish, including salmon (*Oncorhynchus* spp.), rockfish (*Sebastes* spp.), and lingcod (*Ophiodon elongatus*) (Caldwell and Caldwell 1983).

In the Atlantic Ocean, NMFS' most recent stock assessment report notes that sperm whales are distributed in a distinct seasonal cycle, concentrated east-northeast of Cape Hatteras in winter and shifting northward in spring when whales are found throughout the Mid-Atlantic Bight. Distribution extends further northward to areas north of Georges Bank and the Northeast Channel region in summer and then south of New England in fall, back to the Mid-Atlantic Bight. There is also a very large population of sperm whales found in the Gulf of Mexico near the Mississippi River delta.

Life History. Female sperm whales take about 9 years to become sexually mature (Kasuya 1991, as cited in Perry *et al.* 1999). Male sperm whales take between 9 and 20 years to become sexually mature, but will require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). Adult females give birth after about 15 months gestation and nurse their calves for 2 - 3 years. The calving interval is estimated to be about four to six years (Kasuya 1991). The age distribution of the sperm whale population is unknown, but sperm whales are believed to live at least 60 years (Rice 1978). Estimated annual mortality rates of sperm whales are thought to vary by age, but previous estimates of mortality rate for juveniles and adults are now considered unreliable (IWC 1980, as cited in Perry *et al.* 1999). Sperm whales are known for their deep foraging dives (in excess of 3 km). They feed primarily on mesopelagic squid, but also consume octopus, other invertebrates, and fish (Tomilin 1967, Tarasevich1968, Berzin 1971). Perez (1990) estimated that their diet in the Bering Sea was 82% cephalopods (mostly squid) and 18% fish. Fish eaten in the North Pacific included salmon, lantern fishes, lancetfish, Pacific cod, pollack, saffron cod, rockfishes, sablefish, Atka mackerel, sculpins, lumpsuckers, lamprey, skates, and rattails (Tomilin 1967, Kawakami 1980, Rice 1986b). Sperm whales taken in the Gulf of Alaska in the 1960s had fed primarily on fish. Daily food consumption rates for sperm whales ranges from 2 - 4% of their total body weight (Lockyer 1976b, Kawakami 1980). Potential sources of natural mortality in sperm whales include killer whales and papilloma virus (Lambertson *et al.* 1987).

Diving and social behavior. Sperm whales are likely the deepest and longest diving mammals. Typical foraging dives last 40 min and descend to about 400m followed by approximately 8 min of resting at the surface (Gordon 1987; Papastavrou et al. 1989). However, dives of over 2 hr and as deep as 3,000 m have been recorded (Clarke 1976; Watkins et al. 1985). Descent rates recorded from echosounders were approximately 1.7m/sec and nearly vertical (Goold and Jones 1995). There are no data on diurnal differences in dive depths in sperm whales. However, like most diving vertebrates for which there is data (e.g. rorqual whales, fur seals, chinstrap penguins), sperm whales probably make relatively shallow dives at night when organisms from the ocean's deep scattering layers move toward the ocean's surface.

The groups of closely related females and their offspring develop dialects specific to the group (Weilgart and Whitehead 1997) and females other than birth mothers will guard young at the surface (Whitehead 1996b) and will nurse young calves (Reeves and Whitehead 1997).

Vocalizations and hearing. Sperm whales produce loud broadband clicks from about 0.1 to 20 kHz (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). These have source levels estimated at 171 dB re 1 μPa (Levenson 1974). Current evidence suggests that the disproportionately large head of the sperm whale is an adaptation to produce these vocalizations (Norris and Harvey 1972; Cranford 1992; but see Clarke 1979). This suggests that the production of these loud low frequency clicks is extremely important to the survival of individual sperm whales. The function of these vocalizations is relatively well studied (Weilgart and Whitehead 1993, 1997; Goold and Jones 1995). Long series of monotonous regularly spaced clicks are associated with feeding and are thought to be produced for echolocation. Distinctive, short, patterned series of clicks, called codas, are associated with social behavior and intragroup interactions; they are thought to facilitate intra-specific communication, perhaps to maintain social cohesion with the group (Weilgart and Whitehead 1993).

A general description of the anatomy of the ear for cetaceans is provided in the description of the blue whale above. The only data on the hearing range of sperm whales are evoked potentials from a stranded neonate (Carder and Ridgway 1990). These data suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz. Sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins and Schevill 1975; Watkins *et al.* 1985). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Sperm whales have moved out of areas after the start of air gun seismic testing (Davis *et al.* 1995). Seismic air guns produce loud, broadband, impulsive noise (source levels are on the order of 250 dB) with shots at every 15 seconds, 240 shots per hour, and 24 hours per day during active tests. Because they spend large amounts of time at depth and use low frequency sound sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll *et al* 1999). Furthermore, because of their apparent role as important predators of mesopelagic squid and fish, changes in their abundance could affect the distribution and abundance of other marine species.

Status and Trends. Sperm whales have been protected from commercial harvest by the IWC since 1981, although the Japanese continued to harvest sperm whales in the North Pacific until 1988 (Reeves and Whitehead 1997). Sperm whales were listed as endangered under the ESA in 1973. They are also protected by the Convention on International Trade in Endangered Species of wild flora and fauna and the MMPA. Critical habitat has not been designated for sperm whales.

The best abundance estimate that is currently available for the western North Atlantic sperm whale population is 2,698 (CV=0.67) animals, and the minimum population estimate used for NMFS management purposes is 1,617 (CV=0.67) (Waring *et al. in prep.*). Due to insufficient data, no information is available on population trends at this time for the western North Atlantic sperm whale stock.

Threats. In U.S. waters in the Pacific, sperm whales are known to have been incidentally taken only in drift gillnet operations, which killed or seriously injured an average of 9 sperm whales per year from 1991-1995 (Barlow *et al.* 1997). Interactions between longline fisheries and sperm whales in the Gulf of Alaska have been reported over the past decade (Rice 1989, Hill and DeMaster 1999). Observers aboard Alaskan sablefish and halibut longline vessels have documented sperm whales feeding on fish caught in longlines in the Gulf of Alaska. During 1997, the first entanglement of a sperm whale in Alaska's longline fishery was recorded, although the animal was not seriously injured (Hill and DeMaster 1998). The available evidence does not indicate sperm whales are being killed or seriously injured as a result of these interactions, although the nature and extent of interactions between sperm whales and long-line gear is not yet clear.

<u>Protected Species Surveys within the project area.</u>

Surveys specifically targeting protected species were not conducted in the action area, however an Environmental Baseline Study and Impact Assessment were prepared. This assessment, literature reviews and consultations with NMFS serve as the basis for this biological assessment and the determination of which listed and protected species under NMFS' jurisdiction are found in the project area.

<u>Sea Turtles</u>

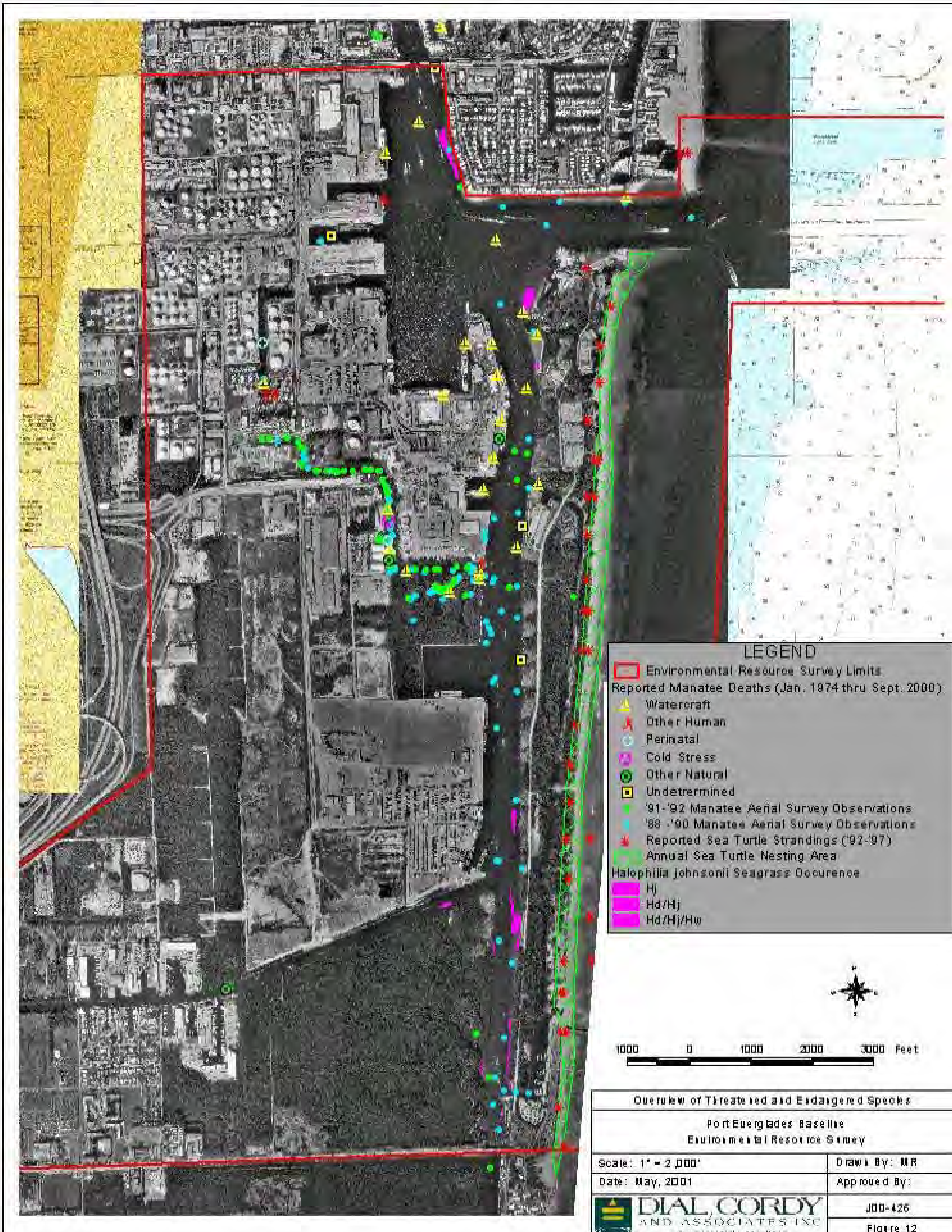
Broward County is within the normal nesting range of three species of sea turtles: the loggerhead (*Caretta caretta*), the green turtle (*Chelonia mydas*), and the leatherback (*Dermochelys coriacea*). The green sea turtle and leatherback sea turtle are both listed under the U. S. Endangered Species Act, 1973 and Chapter 370, F.S. The loggerhead turtle is listed as a threatened species (Burney and Margolis, 1999). A summary of sea turtle nesting in Broward County can be found in Tables 1, 2 and 3 in the species description section of this assessment. The majority of sea turtle nesting activity occurred during the summer months of June, July and August, with nesting activity occurring as early as March and as late as September (Burney and Margolis, 1999). The waters offshore of Broward County are also habitat used for foraging and shelter for the three species listed above and possibly the hawksbill turtle (*Eretmochelys imbricata*), and the Kemp's ridley turtle (*Lepidochelys kempii*) (USACE, 2000) (Figure 3).

Six (6) stranded threatened and endangered sea turtles have been reported within the Port boundaries: 3 loggerheads, 2 green turtles and 1 hawksbill. In addition there were 13 incidental capture records - 1 green turtle was caught on hook and line and 12 turtles (6 loggerheads, 2 green turtles, 2 hawksbills and 2 unidentified species) were caught in the power plant at Port Everglades (Wendy Teas, pers. Comm. 2002).

<u>Johnson's Seagrass</u>

Johnson's seagrass occurs within the project area, specifically in the Intracoastal Waterway east and south of the Main Turning Basin, and just west of the Dania Cutoff Canal, and in the Dania Cutoff Canal. Abundance and density values are low and the species is generally associated with *H. decipiens*. Johnson's seagrass also occurs south of the Dania Cutoff Canal within Whiskey Creek, along the western shore of the Intracoastal Waterway and within the West Lake Park embayment (Miller Legg, 2001). Cover-abundance and density were higher along the west shore of West Lake Park than was observed within the Port Everglades project area. No designated critical habitat is

Fig 3 – Endangered & Threatened Species Locations



found within the project boundaries or within the vicinity of the project site (Figure 4 & 5).

Smalltooth sawfish

This species inhabits softbottom estuarine habitats in depths generally less than 30 feet. Its former range in U.S. waters extended from Texas through Maryland. Currently, few are observed outside peninsular Florida. At least one recorded observation has occurred within the vicinity of Broward County (NMFS, 2000). Populations likely decreased due to a low intrinsic rate of natural increase, the long interval to time of reproduction, and human impacts, most notably overfishing, incidental take in nets (due in part to its body size and unusual morphology), and habitat loss (development of shoreline and nearshore habitats).

Humpback and Sperm Whales

These species are found offshore of the project area in deepwater beyond the third reef line. Sperm whales may be found year round near the project area, while humpbacks are found seasonally during their migration to and from breeding grounds in the Caribbean.

Other consultations of Federal actions in the area to date

The Corps has been working with the citizens of Broward County for several years on expanding and maintaining Port Everglades (Table 4). None of the projects authorized by Congress through 1968 were required to consult under the Endangered Species Act of 1973 (ESA). Port Everglades projects following implementation of the ESA include the 1974 deepening and widening of the entrance channel on a new alignment, as well as deepening the turning basin and add the channel now referred to as the Southport Access Channel.

The Corps is also working with Broward County on the Broward County Shore protection project, located outside of the port boundaries to the north and the south. Construction on the shore protection project is scheduled to begin in the fall of 2004. The Corps believes that the sea turtle species addressed in the current biological assessment may be affected, but not adversely affected in any way by the project. The NMFS Informal Section 7 consultation on that project (March 10, 2000) concurred with the finding of may affect, not likely to adversely affect listed species or adversely effect designated critical habitat under NMFS jurisdiction in the project area (consultation number 1514-22f.1.).

Table 4: Previously Authorized Federal Actions at Port Everglades Harbor

ACTS	WORK AUTHORIZED	DOCUMENTS
3 Jul 1930	Maintenance of harbor constructed by local interests.	H. Doc. 357/71/2
30 Aug 1935	Enlarge entrance channel to existing project dimensions and complete turning basin to 1,200 feet square.	R. & H. Comm. Doc. 25/74/1
20 Jun 1938	Widen turning basin 350 feet on north side.	H. Doc. 545/75/3
24 Jul 1946	Widen turning basin 200 feet on north side, 500 feet	H. Doc. 768/78/2

Fig 4 – Seagrass Locations in Northern portion

Fig 5 – Seagrass Locations in Southern portion

	on south side, and enlarge flare at entrance channel.	
3 Jul 1958	Deepen and widen entrance channel on a new alignment and increase turning basin in size and depth.	H. Doc. 346/85/2
H.R. 9 May 1974 S.R.31 May 1974	Deepen and widen entrance channel on a new alignment, deepen turning basin and add a new channel to the southeast of the turning basin.	H. Doc. 144/93/1

Projects completed by the Port without Federal assistance

1987	Port Everglades. Final Environmental Impact Statement, Proposed Expansion Port Everglades, Broward County, Florida. EIS for deepening and widening the Southport Access Channel, bulkheading port land, creation of the Turning Notch.

Protective Measures Taken in the Project Area as Part of the Proposed Action

Consideration of Plans and Methods to Minimize/Avoid Environmental Impacts. Conservation measures were a major focus during the plan formulation phase for the proposed project. Avoiding and minimizing some potential impact areas significantly decreased the risk of indirect effects on managed and protected species, and a great deal of consideration was given to the utilization of rock removal methods to decrease the likelihood of incidental take, injury, and behavioral modification of protected species. While efforts to reduce impacts to habitats were fruitful, it was determined that rock removal options not involving blasting were possibly more detrimental to populations and individuals of protected species. One alternative option was the use of a punchbarge/piledriver to break rock. However, it was determined that the punchbarge, which would work for 12-hour periods, strikes the rock approximately once every 60-seconds. This constant pounding would serve to disrupt animal behavior in the area. Using the punchbarge would also extend the length of the project, thus increasing any potential impacts to all fish and wildlife resources in the area. The Corps believes that blasting is actually the least environmentally damaging method for removing the rock in the Port. Each blast will last no longer than five (5) seconds in duration, and may even be as short as 2 seconds each. Additionally, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set, and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast (see discussion below).

Development of Protective Measures. The proposed project includes measures to conserve sperm and humpback whale, sea turtles and smalltooth sawfish. Foremost among the measures are protective actions to ensure that sea turtles and smalltooth sawfish are not killed and whales are not harassed due to blasting activities, if in fact such methods are required as a part of the overall dredging operation. Development of the measures involved consideration of past practices and operations, anecdotal observations, and the most current scientific data. The discussion below summarizes the development of the conservation measures, which, although developed for marine mammals, will also be utilized to protect such species as sea turtles and smalltooth sawfish.

Blasting

To achieve the deepening of the Port Everglades pretreatment of the rock areas may be required. Blasting is anticipated to be required for some or all of the deepening and extension of the channel, where standard construction methods are unsuccessful. The work may be completed in the following manner:

1. Contour dredging with either bucket, hydraulic or excavator dredges to remove material that can be dredged conventionally and determine what areas require blasting.

2. Pre-treating (blasting) the remaining above grade rock, drilling and blasting the "Site Specific" areas where rock could not be conventionally removed by the dredges.

3. Excavating with bucket, hydraulic or excavator dredges to remove the pre-treated rock areas to grade.

All drilling and blasting will be conducted in strict accordance with local, state and federal safety procedures. Marine Wildlife Protection, Protection of Existing Structures, and Blasting Programs coordinated with federal and state agencies.

Based upon industry standards and USACE, Safety & Health Regulations, the blasting program may consist of the following:

The weight of explosives to be used in each blast will be limited to the lowest poundage of explosives that can adequately break the rock. The blasting would consist of up to 3 blasts per day, preparing for removal of approximately 1500 cubic yards per blast.

The following safety conditions are standard in conducting underwater blasting:

- Drill patterns are restricted to a minimum of 8 ft separation from a loaded hole.
- Hours of blasting are restricted from 2 hours after sunrise to 1 hour before sunset to allow for adequate observation of the project area for protected species.
- Selection of explosive products and their practical application method must address vibration and air blast (overpressure) control for protection of existing structures and marine wildlife.
- Loaded blast holes will be individually delayed to reduce the maximum pounds per delay at point detonation, which in turn will reduce the mortality radius.
- The blast design will consider matching the energy in the “work effort” of the borehole to the rock mass or target for minimizing excess energy vented into the water column or hydraulic shock.

Because of the potential duration of the blasting and the project area as habitat for listed and threatened species, a number of issues will need to be addressed. One of the key issues is the extent of a safety radius for the protection of marine wildlife. This is the distance from the blast site which any protected species must be in order to commence blasting operations. Ideally the safety radius is large enough to offer a wide buffer of protection for marine animals while still remaining small enough that the area can be intensely surveyed

There are a number of methods that can be used to calculate a safety radius. Little published data exists for actual measurements of sub aqueous blasts confined to a rock layer and their impacts to marine mammals or turtles. There is some information on the impacts to fish from similar blasts. Both literature searches and actual observations from similar blasting events will be used as a guide in establishing a safety radius that affords the best protection from lethal harm to marine wildlife. The following will be considered in establishing the radius for blasting inshore of the outer reef:

The U.S. Navy Dive Manual and the FFWCC Endangered Species Watch Manual the safety formula for an uncontrolled blast suspended in the water column, which is as follows:

R = 260 (cube root w)
R = Safety radius

W = Weight of explosives

This formula is a conservative for the blasting being done within Port Everglades, as the blast will be confined within the rock and not suspended in the water column. This formula and plan are consistent with the plans for Miami Harbor Phase II and Miami Harbor GRR that the Corps consulted with NMFS on (I/SER/2002/00178 – September 23, 2002 and F/SER/2002/01094 – February 23, 2003, respectively). In both cases, NMFS found concurred with the Corps' determination that the proposed confined blasting at Miami Harbor "may affect, but is not likely to adversely affect sea turtles". The Port Everglades blasting plan has been designed to be consistent with the Miami Harbor projects. Should new information come from the Miami harbor projected (Phase II is scheduled to begin construction in Fall 2004) that would result in changes (as lessons learned) they will be incorporated into the plans for Port Everglades in consultation with all the resource agencies.

If blasting is required on the outer reef, the Corps proposes to use aerial and passive acoustic surveys to determine if there are sperm or humpback whales within a 1-nautical mile (nm) radius of the project area. In the Biological Opinion for the shock trial of the USS Winston Churchill (DDG-81) (NMFS, 2000b), NMFS required the Navy to establish a zone of 3 nm for acoustic monitoring and 2 nm for aerial monitoring for three 10,000 lb open water unconfined explosions. Blasting for the channel extension will utilize confined blasts drilled into the substrate, and as a result the Corps believes that any acoustic or pressure effects to the project area will be substantially less than those evaluated by NMFS in setting the safety zones for the Churchill tests.

Conservation Measures

It is crucial to balance the demands of the blasting operations with the overall safety of the species. A radius that is excessively large will result in significant delays that prolong the blasting, construction, traffic and overall disturbance to the area. A radius that is too small puts the animals at too great of a risk should one go undetected by the observers and move into the blast area. Because of these factors, the goal is to establish the smallest radius possible without compromising animal safety and provide adequate observer coverage for whatever radius is agreed upon.

Aerial reconnaissance, where feasible and possible, is critical to support the safety radius selected in addition to boat-based and land support reconnaissance. Additionally, an observer will be placed on the drill barge for the best view of the actual blast zone and to be in direct contact with the blaster in charge.

Prior to implementing a blasting program a Test Blast Program will be completed. The purpose of the Test Blast Program is to demonstrate and/or confirm the following:

- Drill Boat Capabilities and Production Rates
- Ideal Drill Pattern for Typical Boreholes
- Acceptable Rock Breakage for Excavation
- Tolerable Vibration Level Emitted

- Directional Vibration
- Calibration of the Environment

The Test Blast Program begins with a single range of individually delayed holes and progresses up to the maximum production blast intended for use. Each Test Blast is designed to establish limits of vibration and airblast overpressure, with acceptable rock breakage for excavation. The final test event simulates the maximum explosive detonation as to size, overlying water depth, charge configuration, charge separation, initiation methods, and loading conditions anticipated for the typical production blast.

The results of the Test Blast Program will be formatted in a regression analysis with other pertinent information and conclusions reached. This will be the basis for developing a completely engineered procedure for Blasting Plan. During the testing the following data will be used to develop a regression analysis:

- Distance
- Pounds Per Delay
- Peak Particle Velocities (TVL)
- Frequencies (TVL)
- Peak Vector Sum
- Air Blast, Overpressure

Other Rock Removal Options

The Corps investigated methods to remove the rock in Port Everglades without blasting using a punchbarge. It was determined that the punchbarge, which would work for 12-hour periods, strikes the rock below approximately once every 60-seconds. This constant pounding would serve to disrupt manatee behavior in the area, as well as impact other marine animals in the area. Using the punchbarge will also extend the length of the project temporally, thus increasing any potential impacts to all fish and wildlife resources in the area. A punchbarge has been tried in the past at Port Everglades without success due to rock hardness.

The Corps believes that blasting is actually the least environmentally damaging method for removing the rock in the Port. Each blast will last no longer than 5-seconds in duration, and may even be as short as 2 seconds, occurring no more than three times per day. As stated previously, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast.

<u>Effects of the Action on Protected Species.</u>

As previously stated, the Corps believes that the loggerhead turtle, green turtle, smalltooth sawfish and Johnson's seagrass have the potential to be effected by the proposed dredging project. The project may have the following adverse impacts on listed/protected species are:

- direct effect of blasting in the turning basin.

- direct effect of dredging activities
- indirect effects

Direct Effects

Blasting

Sea turtles

Specific information regarding the likely direct impact of explosives on sea turtles is not available. Studies regarding the impacts of relatively minuscule explosives on humans noted that minor injuries such as small bruises or perforations of the intestinal tract occasionally occur well beyond ranges in which human lung damage could occur (Christian and Gaspin, 1974). Christian and Gaspin (1974) note that these minor injuries could become serious if left unattended. Sea turtles with untreated internal injuries would have increased vulnerability to predators and disease. In the Environmental Impact Statement prepared by the Navy to consider the effects of explosives used in shipshock tests, nervous system damage was cited as a possible impact to sea turtles caused by blasting. Damage of the nervous system could kill sea turtles through disorientation and subsequent drowning. The Navy's review of previous studies suggested that rigid masses such as bone (or carapace and plastron) could protect tissues beneath them; however, there are no observations available to determine whether the turtles' shells would indeed afford such protection.

Studies conducted by Klima *et al*., (1988) evaluated blasts of only approximately 42 lbs on sea turtles (4 ridleys, 4 loggerheads) placed in surface cages at varying distances from the explosion. Christian and Gaspin's (1974) estimates of safety zones for swimmers found that, beyond a cavitation area, waves reflected off a surface have reduced pressure pulses; therefore, an animal at shallow depths would be exposed to a reduced impulse. This finding, which considered only very small explosive weights, implies that the turtles in the Klima *et al*. (1988) study would be under reduced effects of the shock wave. Despite this possible lowered level of impact, 5 of 8 turtles were rendered unconscious at distances of 229 to 915 m from the detonation site. Unconscious sea turtles that are not detected, removed and rehabilitated likely have low survival rates.

Blasting will affect nearby finfish and invertebrates and cause short-term changes to the physical characteristics of the benthos. Fish and invertebrates killed or injured by the blasting may provide a short-term enhancement of foraging opportunities for green and loggerhead sea turtles. Through new recruitment and local migrations, finfish and benthic invertebrates are expected eventually to repopulate the affected area. Any modifications of the local area's environment, as far as sea turtle habitat, are not expected to be significant in the long term.

Smalltooth Sawfish

Blasting rock underwater produces a pressure wave in water that can produce fish mortality. Different types of fish have different mortality thresholds. This depends on whether the fish dwell near the surface, on the bottom, or in between.

The magnitude of the pressure wave generated in greatly affected by the stemming of the blastholes, distance between holes, and the delay time of the holes.

Normally, mortality occurs in the range of 150-psi overpressure for fish. In practice this is a 75-foot to 100-foot radius around the blasting area.

Dredging

Sea Turtles

The effects of hopper dredging on sea turtles on the Atlantic coast were analyzed by NMFS in the 1997 biological opinion entitled "The continued hopper dredging of channels and borrow areas in the southeastern United States". If it is determined that a hopper dredge will be used, the Terms and Conditions of this opinion will be applied to the project. If a cutterhead or clamshell dredge is used, based on a finding in the November 25, 1991 biological opinion between NMFS and the Corps that states:

> "Pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead and be caught in the suction. This type of behavior would appear unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely effect sea turtles".

Based on this determination, the Corps finds that use of a cutterhead dredge may effect, but is not likely to adversely affect sea turtles. If a clamshell dredge is used, there is no suction to capture a sea turtle and the turtle would have to be caught between the two halved of the clamshell. While this is not impossible, it is improbable. The Corps has also determined that use of a clamshell dredge may effect, but is not likely to adversely affect sea turtles.

Smalltooth sawfish

The smalltooth sawfish may be affected by dredging nearshore areas in channels that are currently suitable habitats (areas of sand and/or mud bottoms less than 30 feet in depth) and by blasting if there is an animal present in the blast zone at time of detonations, a stunned or damaged animal may be captured by the clamshell dredge if it could not move out of the way.

Johnson's Seagrass

Dredging will result in the removal of approximately 2.37 acres of seagrass beds where *H. johnsonii* is the sole constituent or associate of other seagrass species in the Intracoastal Waterway and Dania Cutoff Canal. This impact will include the direct removal of *H. johnsonii.* Changes in bottom depth through deepening and widening efforts within the Port is expected to make resulting habitats unsuitable for re-colonization of *H. johnsonii*. It is not known if *H. johnsonii* in areas adjacent to dredging zones would be resilient to changes in water quality or to impacts resulting from deposition of sediments on blades.

Indirect Effects

Sea Turtles

Since beaches of John U. Lloyd SRA provide important nesting areas for three sea turtle species, the project area comprises important resources for turtles. Removal of sections of hardbottom, reef, and seagrass habitats will eliminate potential foraging habitat for juvenile sea turtles. The reduction in such habitat may slightly decrease the carrying capacity of the region for turtles. Also, since these habitats are also utilized as refugia for hatchling turtles, an increase in predation may be anticipated.

Finally, dredge activities and associated disturbances (noise, lights, etc.) offshore may interrupt the movement of turtles swimming toward or away from nesting beaches. In fact, the highest potential impact to sea turtles may be the use of explosives to remove areas of rock within the Entrance and Southport Access Channels. It is extremely likely that both the pressure and noise associated with blasting will physically damage sensory mechanisms and other physiological functions of individual sea turtles.

Johnson's seagrass

Areas of Johnson's seagrass adjacent to construction activities may be temporarily affected by increased turbidity and lower water clarity during construction.

Effect Determination

The Corps has determined that the proposed expansion of Port Everglades may adversely affect listed and proposed species within the action area and requests initiation of formal consultation with NMFS.

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Planning Division
Environmental Branch

Ms. Georgia Cranmore
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
9721 Executive Center Drive North
St. Petersburg, Florida 33702

Dear Ms. Cranmore:

The U.S. Army Corps of Engineers (Corps), Jacksonville District proposes to conduct a feasibility study to assess Federal interest in navigation improvements throughout Port Everglades. An evaluation of benefits, costs, and environmental impacts determines Federal interest. This Feasibility Study was authorized by a resolution of the House Committee on Transportation dated May 9, 1996.

The Recommended Plan main elements include: widening and deepening (to –53/-50 feet) the Outer Entrance Channel, deepening the Inner Entrance Channel and Main Turning Basin to –50 feet, widening and deepening (to –47 feet) the Southport Access Channel, widening and deepening (to –32 feet) the Dania Cutoff Canal, constructing a Turning Basin at the intersection of the Dania Cutoff Canal and the Southport Access Channel at –32 feet, deepening a portion of the South Turning Basin to –44 feet, and widening and deepening (to –47 feet) the Turning Notch. Other significant construction items include relocation of the U.S. Coast Guard (USCG) Basin easterly within essentially USCG property, port facility construction, and environmental mitigation.

Enclosed please find the Corps’ biological assessment of the effects of the proposed project on listed species and marine mammals in the action area and a copy of the draft Environmental Impact Statement prepared for this proposed project.

We request initiation of consultation under section 7 of the Endangered Species Act concerning the effects of the proposed activities on the smalltooth sawfish, green, hawksbill, Kemp’s ridley and loggerhead sea turtles and Johnson’s seagrass. We also request an initiation of consultation under the Marine Mammal Protection Act of 1972 concerning effects of the proposed activities on marine mammals within the action area.

If you have any questions, please contact Ms. Terri Jordan at 904-899-5195 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Jordan/CESAJ-PD-EA/3453/
McAdams/CESAJ-PD-EA
Dugger/CESAJ-PD-E
Scarborough/CESAJ-DP-C
Strain/CESAJ-PD-P
Duck/CESAJ-PD

L: group/pde/jordan/Sect 7 cover letter NMFS

BIOLOGICAL ASSESSMENT
PORT EVERGLADES NAVIGATION PROJECT
BROWARD COUNTY, FLORIDA

Description of the Proposed Action

The U.S. Army Corps of Engineers (Corps) proposes to expand and deepen Port Everglades Harbor. A detailed description of the proposed project and all alternatives considered under the Feasibility Study are evaluated in the pending Draft Environmental Impact Statement. Broward County Port Department requested that the Corps study the feasibility of widening and deepening most of the major channels and basins within Port Everglades. Four major improvement goals were identified. 1) Improve transit in the Outer Entrance Channel (OEC), Inner Entrance Channel (IEC), Main Turning Basin (MTB) and Southport Access Channel (SAC) to accommodate liquid bulk, cruise, and container vessels; 2) Develop the Dania Cutoff Canal (DCC) to accommodate mid-size vessels; 3) Deepen the North Turning Basin to accommodate Panamax size container ships; and 4) Improve turning and berthing in the Turning Notch.

The purpose of the proposed action is to provide increased safety, efficiency and lower costs for future port navigation and utilization, while protecting the environment. The proposed action resulted from a comprehensive analysis of all the existing and future commercial vessel transit needs within the port. This economic analysis has shown that improvements to most of the major Federal and non-Federal channels and basins are required to achieve efficient transit of the existing fleet, and to accommodate the future fleet. Substantial liquid bulk cargo cost savings can be achieved by deepening the OEC, IEC, and MTB. Widening of the OEC flare will allow safer transit for all the larger commercial vessels that experience sometimes troublesome cross currents at the channel entrance. Removal of the Widener Shoal and widening of the SAC allows for more efficient and safer transits of containerized cargo vessels past the Knuckles restriction where new generation cruise vessels are expected to be berthed. Lengthening and deepening of the TN will provide turning possibilities for larger vessels and will provide critical berthing for containerized cargo vessels. Deepening of the STB will allow for more efficient use Berths 16-18 by allowing Panamax vessel calls. Finally, widening and deepening of the DCC (in addition to a turning basin located adjacent to the SAC) will allow for relocation of smaller and midsize container, roll on/roll off (ro/ro) vessels, and general cargo traffic, thereby reducing congestion in the areas serviced by larger vessels.

The Corps expects the construction to be performed using a variety of methods including blasting and dredging with a cutterhead, clamshell, hopper or other type of dredge. Any blasting that will occur within the project will be confined blasting. Confined blasting is defined as a blast where the explosives had been placed in a hole bored into the rock substrate and capped with 3-4 feet of crushed rock known as “stemming”. Stemming forces the explosive blast downward into the rock instead of allowing the blast to expand into the water column.

Action Area

The Port Everglades Harbor is a major seaport located on the southeast coast of Florida, approximately 27 nautical miles (nm) north of Miami Harbor. The Harbor lies adjacent to cities of Dania and Fort Lauderdale (Broward County), with immediate access to the Atlantic Ocean and the Intracoastal Waterway. The entrance of the Port is approximately 27 nautical miles north of Miami Harbor, Florida and 301 nautical miles south of Jacksonville Harbor, Florida. **Figure 1** shows major features located within and surrounding the project site.

Protected Species Included in this Assessment

Of the listed and protected species under NMFS jurisdiction occurring in the action area, the Corps believes that the green turtle (*Chelonia mydas*), loggerhead turtle (*Caretta caretta*), smalltooth sawfish (*Pristis pectinata*), Kemp's ridley turtle (*Lepidochelys kempii*), Hawksbill sea turtle (*Eretmochelys imbricata*), Johnson’s seagrass (*Halophila johnsonii*) may be adversely affected by the implementation of the Navigation Project.

Additional endangered species that are known to occur along the Atlantic coast include the finback (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), and sperm (*Physeter macrocephalus*) whales, and the leatherback sea turtle (*Dermochelys coriacea*). The Corps has determined that these species are unlikely to be adversely affected by the proposed construction activities.

The endangered Florida manatee (*Trichecus manatus*) also occurs with the action area and the Corps has initiated consultation with the U.S. Fish and Wildlife Service concerning the effects of the proposed action on that species.

Status and Distribution of the Species

Green Turtle

Green turtles are distributed circumglobally. In the western Atlantic they range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare north of Cape Hatteras (Wynne and Schwartz, 1999). Several major nesting assemblages have been identified and studied in the western Atlantic (Peters 1954; Carr and Ogren, 1960; Carr *et al.*, 1978). Most green turtle nesting in the continental United States occurs on the Atlantic Coast of Florida (Ehrhart 1979). Green turtles are the largest of the hard-shelled sea turtles. Adult male green turtles are smaller than adult females whose lengths range from 92 to 110 cm (36 to 43 in.) and weights range from 119 to 182 kg (200 to 300 lbs). Their heads are small compared to other sea turtles and the biting edge of their lower jaws is serrated.

Green turtles have a more tropical distribution than loggerhead turtles; they are generally found in waters between the northern and southern 20^{o}C isotherms (Hirth 1971). Green turtles, like most other sea turtles, are distributed more widely in the summer when warmer water temperatures allow them to migrate north along the Atlantic coast of North America. In the summer, green turtles are found around the U.S. Virgin Islands, Puerto Rico, and continental North America from Texas to Massachusetts. Immature greens can be distributed in estuarine and coastal waters from Long Island Sound, Chesapeake Bay, and the North Carolina sounds south throughout the tropics (Musick and Limpus, 1997). In the United States, green turtles nest primarily along the Atlantic Coast of Florida, the U.S. Virgin Islands, and Puerto Rico. In the winter, as water temperatures decline, green turtles that are found north of Florida begin to migrate south into subtropical and tropical water.

The green turtle was protected under the ESA in 1978; breeding populations off the coast of Florida and the Pacific coast of Mexico are listed as endangered, all other populations are listed as threatened. The greatest threat to this species is the loss of its nesting habitat. Throughout the tropical and subtropical distribution of this species, beaches are eroded, armored, renourished, or converted for residential or commercial purposes. Green turtles are also threatened by fibropapilloma disease; incidental takes in commercial or recreational fishing gear; and poaching (although poaching is infrequent in the United States). Green turtles are harvested in some nations for food, leather, and jewelry. Green turtles are also threatened by natural causes including hurricanes and predation by exotic species (fire ants, raccoons (*Procyon lotor*) and opossums (*Didelphus virginiana*)) and by poaching of eggs and nesting females.

There is evidence that green turtle nesting has been on the increase during the past decade. Recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches where most green turtle nesting activity occurs have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the six years of regular monitoring since establishment of the index beaches in 1989. Recent population estimates for the western Atlantic area are not available.

While nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida, the northwestern coast of the Yucatan Peninsula, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet (Bjorndal 1997). Post-pelagic green turtles feed primarily on sea grasses and benthic algae but also consume jellyfish, salps, and sponges. In the western Atlantic region, the summer developmental habitat encompasses estuarine and coastal waters as far north as Long Island Sound, Chesapeake Bay, and North Carolina sounds, and south throughout the tropics (Musick and Limpus, 1997). Like loggerheads and Kemp's ridleys, green sea turtles that use northern waters during the summer must return to southern waters in autumn, or face the risk of cold stunning.

General human impacts and entanglement
Anthropogenic impacts to the green sea turtle population are similar to those discussed above for other sea turtles species. Sea sampling coverage in the pelagic driftnet, pelagic longline, scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. In addition, the NMFS/Northeast Fisheries Science Center (NEFSC) is conducting a review of bycatch levels and patterns in all fisheries in the western Atlantic for

which observer data is available. Bycatch estimates will be made for all fisheries for which sample sizes are sufficiently large to permit reasonable statistical analysis. This will be compiled into an assessment report. Until that analysis is completed, the only information on the magnitude of takes available for fisheries in the action area are unextrapolated numbers of observed takes from the sea sampling data. Preliminary sea sampling data summary (1994-1998) shows the following total take of green turtles: one (anchored gillnet), two (pelagic driftnet), and two (pelagic longline). Stranding reports indicate that between 200-300 green turtles strand annually from a variety of causes (Sea Turtle Stranding and Salvage Network, unpublished data). As with the other species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality.

In 1998, NMFS designated the waters surrounding the islands of Culebra, Puerto Rico as critical habitat for the green turtle. This area supports major seagrass beds and reefs that provide forage and shelter habitat.

Loggerhead Turtle

The loggerhead sea turtle was listed as threatened under the ESA on July 28, 1978. Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans and are the most abundant species of sea turtle occurring in U.S. waters. Loggerhead sea turtles concentrate their nesting in the north and south temperate zones and subtropics, but generally avoid nesting in tropical areas of Central America, northern South America, and the Old World (NRC 1990). The largest known nesting aggregation of loggerhead sea turtles occurs on Masirah and Kuria Muria Islands in Oman (Ross and Barwani, 1982). In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the gulf coast of Florida. The best scientific and commercial data available on the genetics of loggerhead sea turtles suggests there are four major subpopulations of loggerhead sea turtles in the northwest Atlantic: (1) a northern nesting subpopulation that occurs from North Carolina to northeast Florida, about 29^{o} N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29^{o} N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); and (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez 1990)(approximately 1,000 nests in 1998)(TEWG 2000). This biological opinion will focus on the northwest Atlantic subpopulations of loggerhead sea turtles, which occur in the action area.

Although NMFS and FWS have not completed the administrative processes necessary to formally recognize populations or subpopulations of loggerhead sea turtles, these sea turtles are generally grouped by nesting locations. Based on the most recent reviews of the best scientific and commercial data on the population genetics of loggerhead sea turtles and analyses of their population trends (TEWG, 1998; TEWG 2000), NMFS and FWS treat these loggerhead turtle nesting aggregations as distinct subpopulations whose survival and recovery is critical to the survival and recovery of the species. Further, any action that appreciably reduced the likelihood that one or more of these nesting aggregations would survive and recover would appreciably reduce the species' likelihood of survival and recovery in the wild. Consequently, this biological opinion will focus on the four nesting aggregations of loggerhead sea turtles identified in the preceding paragraph (which occur in the action area) and treat them as subpopulations for the purposes of this analysis. Natal homing to the nesting beach provides the genetic barrier between these subpopulations, preventing recolonization from turtles from other nesting beaches. The importance of maintaining these subpopulations in the wild is shown by the many examples of extirpated nesting assemblages in the world. In addition, recent fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco *et al.* 2000) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, LeBuff 1990, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but generally are rare (Ehrhart 1979; LeBuff 1974, 1990; CMTTP; Bjorndal *et al.* 1983 : *in* NMFS SEFSC 2001).

The loggerhead sea turtles in the action area are likely to represent differing proportions of the four western Atlantic subpopulations. Although the northern nesting subpopulation produces about 9% of the loggerhead nests, they comprise more of the loggerhead sea turtles found in foraging areas from the northeastern U.S. to Georgia: between 25 and 59 percent of the loggerhead sea turtles in this area are from the northern subpopulation (NMFS SEFSC 2001; Bass *et al*., 1998; Norrgard, 1995; Rankin-Baransky, 1997; Sears 1994, Sears *et al.*, 1995). In the Carolinas, the northern subpopulation is estimated to make up from 25% to 28% of the loggerheads (NMFS SEFSC 2001; Bass *et al.* 1998, 1999). About ten percent of the loggerhead sea turtles in foraging areas off the Atlantic coast of central Florida are from the northern subpopulation (Witzell *et al*., in prep). In the Gulf of Mexico, most of the loggerhead sea turtles in foraging areas will be from the South Florida subpopulation, although the northern subpopulation may represent about 10% of the loggerhead sea turtles in the Gulf (Bass pers. comm). In the Mediterranean Sea, about 45 - 47 percent of the pelagic loggerheads are from the South Florida subpopulation and about two percent are from the northern subpopulation, while only about 51% originated from Mediterranean nesting beaches (Laurent *et al.*, 1998). In the vicinity of the Azores and Madiera Archipelagoes, about 19% of the pelagic loggerheads are from the northern subpopulation, about 71% are from the South Florida subpopulation, and about 11% are from the Yucatán subpopulation (Bolten *et al*., 1998).

Loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years. Turtles in this life history stage are called “pelagic immatures” and are best known from the eastern Atlantic near the Azores and Madeira and have been reported from the Mediterranean as well as the eastern Caribbean (Bjorndal *et al*., in press). Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm SCL they recruit to coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico.

Benthic immatures have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in northeastern Mexico (R. Márquez-M., pers. comm.). Large benthic immature loggerheads (70-91 cm) represent a larger proportion of the strandings and in-water captures (Schroeder *et al.*, 1998) along the south and western coasts of Florida as compared with the rest of the coast, but it is not known whether the larger animals actually are more abundant in these areas or just more abundant within the area relative to the smaller turtles.

Benthic immature loggerheads foraging in northeastern U.S. waters are known to migrate southward in the fall as water temperatures cool (Epperly *et al.*, 1995; Keinath, 1993; Morreale and Standora, 1999; Shoop and Kenney, 1992), and migrate northward in spring. Given an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer and Limpus, 1998), the benthic immature stage must be at least 10-25 years long. NMFS SEFSC 2001 analyses conclude that juvenile stages have the highest elasticity and maintaining or decreasing current sources of mortality in those stages will have the greatest impact on maintaining or increasing population growth rates.

Although loggerhead sea turtles are most vulnerable to pelagic longlines during their pelagic, immature life history stage, there is some evidence that benthic immatures may also be captured, injured, or killed by pelagic fisheries. Recent studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic immatures, followed by permanent settlement into benthic environments. Some may not totally circumnavigate the North Atlantic. In addition, some of these turtles may either remain in the pelagic habitat in the North Atlantic longer than hypothesized or they may move back and forth between pelagic and coastal habitats (Witzell in prep.). Any loggerhead sea turtles that follow this developmental model would be adversely affected by shark gill nets and shark bottom longlines set in coastal waters, in addition to pelagic longlines.

Adult loggerhead sea turtles have been reported throughout the range of this species in the U.S. and throughout the Caribbean Sea. As discussed in the beginning of this section, they nest primarily from North Carolina southward to Florida with additional nesting assemblages in the Florida Panhandle and on the Yucatán Peninsula. Non-nesting, adult female loggerheads are reported throughout the U.S. and Caribbean Sea; however, little is known about the distribution of adult males who are seasonally abundant near nesting beaches during the nesting season. Aerial surveys suggest that loggerheads (benthic immatures and adults) in U.S. waters are distributed in the following proportions: 54% in the southeast U.S. Atlantic, 29% in the northeast U.S. Atlantic, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998).

Based on the data available, it is not possible to estimate the size of the loggerhead sea turtle population in the U.S. or its territorial waters. There is, however, general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage. Nesting data collected on index nesting beaches in the U.S. from 1989-1998 represent the best dataset available to index the population size of loggerhead sea turtles. However, an important caveat for population trends analysis based on nesting beach data is that this may reflect trends in adult nesting females, but it may not reflect overall population growth rates. Given this, between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016-89,034 annually, representing, on average, an adult female population of 44,780 [(nests/4.1) * 2.5]. On average, 90.7% of the nests were from the South Florida subpopulation, 8.5% were from the northern subpopulation, and 0.8% were from the Florida Panhandle subpopulation. There is limited nesting throughout the Gulf of Mexico west of Florida, but it is not known to what subpopulation they belong. Based on the above, there are only an estimated 3,800 nesting females in the northern loggerhead subpopulation. The status of this population, based on number of loggerhead nests, has been classified as stable or declining

(TEWG 2000). Another consideration adding to the vulnerability of the northern subpopulation is that NMFS scientists estimate, using genetics data from Texas, South Carolina, and North Carolina in combination with juvenile sex ratios from those states, that the northern subpopulation produces 65% males, while the Florida subpopulation is estimated to produce 80% females (NMFS SEFSC 2001, Part I).

From a global perspective, the southeastern U.S. nesting aggregation is critical to the survival of this species: it is second in size only to the nesting aggregations in the Arabian Sea off Oman and represents about 35 and 40 percent of the nests of this species. The status of the Oman nesting beaches has not been evaluated recently, but they are located in a part of the world that is vulnerable to extremely disruptive events (e.g. political upheavals, wars, and catastrophic oil spills), the resulting risk facing this nesting aggregation and these nesting beaches is cause for considerable concern (Meylan *et al*., 1995).

Like other sea turtles, the movements of loggerheads are influenced by water temperature. Since they are limited by water temperatures, sea turtles do not usually appear on the summer foraging grounds until June, but are found in Virginia as early as April. The large majority leaves the Gulf of Maine by mid-September but may remain in these areas until as late as November and December. Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Wynne and Schwartz, 1999). Under certain conditions they may also scavenge fish, particularly if they are easy to catch (e.g., caught in nets) (NMFS and USFWS, 1991).

General Human-related Impacts

Loggerhead sea turtles face a number of threats in the marine environment, including oil and gas exploration, development, and transportation; marine pollution; trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries; underwater explosions; dredging, offshore artificial lighting; power plant entrapment; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; and poaching. On their nesting beaches in the U.S., loggerhead sea turtles are threatened with beach erosion, armoring, and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; exotic dune and beach vegetation; predation by exotic species such as fire ants, raccoons (*Procyon lotor*), armadillos (*Dasypus novemcinctus*), opossums (*Didelphus virginiana*); and poaching.

Loggerhead sea turtles also face numerous threats from natural causes. For example, there is a significant overlap between hurricane seasons in the Caribbean Sea and northwest Atlantic Ocean (June to November) and loggerhead sea turtle nesting season (March to November); hurricanes can have potentially disastrous effects on the survival of eggs in sea turtle nests. In 1992, Hurricane Andrew affected turtle nests over a 90-mile length of coastal Florida; all of the eggs were destroyed by storm surges on beaches that were closest to the eye of this hurricane (Milton *et al*., 1992). On Fisher Island near Miami, Florida, 69 % of the eggs did not hatch after Hurricane Andrew, probably because they were drowned by the storm surge. Nests from the northern subpopulation were destroyed by hurricanes, which made landfall in North Carolina in the mid to late 1990's. Sand accretion and rainfall that result from these storms can appreciably reduce hatchling success. These natural phenomena probably have significant, adverse effects on the size of specific year classes; particularly given the increasing frequency and intensity of hurricanes in the Caribbean Sea and northwest Atlantic Ocean.

Status and Trend of Loggerhead Sea Turtles

The most recent work updating what is known regarding status and trends of loggerhead sea turtles is contained in NMFS SEFSC 2001. The recovery plan for this species (NMFS and USFWS 1991) state that southeastern U.S. loggerheads can be considered for delisting if, over a period of 25 years, adult female populations in Florida are increasing and there is a return to pre-listing annual nest numbers totaling 12,800 for North Carolina, South Carolina, and Georgia combined. This equates to approximately 3,100 nesting females per year at 4.1 nests per female per season. NMFS SEFSC 2001 concludes, "…nesting trends indicate that the numbers of females associated with the South Florida subpopulation are increasing. Likewise, nesting trend analyses indicate potentially increasing nest numbers in the northern subpopulation" (TEWG 2000). However, NMFS SEFSC 2001 also cautions that given the uncertainties in survival rates (of the different life stages, particularly the pelagic immature stage), and the stochastic nature of populations, population trajectories should not be used now to quantitatively assess when the northern subpopulation may achieve 3,100 nesting females.

Several published reports have presented the problems facing long-lived species that delay sexual maturity in a world replete with threats from a modern, human population (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high, annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general rule applies to sea turtles, particularly loggerhead sea turtles, because the rule originated in studies of sea turtles (Crouse *et al.*, 1987, Crowder *et al.*, 1994, Crouse 1999). Heppell *et al.* (in prep.) specifically showed that the growth of the loggerhead sea turtle population was particularly sensitive to changes in the annual survival of both juvenile and adult sea turtles and that the adverse effects of the pelagic longline fishery on loggerheads from the pelagic immature phase appeared critical to the survival and recovery of the species. Crouse (1999) concluded that relatively small changes in annual survival rates of both juvenile and adult loggerhead sea turtles would adversely affect large segments of the total loggerhead sea turtle population.

The four major subpopulations of loggerhead sea turtles in the northwest Atlantic, northern, south Florida, Florida panhandle, and Yucatán are all subject to fluctuations in the number of young produced annually because of natural phenomena like hurricanes as well as human-related activities. Although sea turtle nesting beaches are protected along large expanses of the northwest Atlantic coast (in areas like Merrit Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection and probably cause fluctuations in sea turtle nesting success. Sea turtles nesting in the southern and central counties of Florida can be affected by beach armoring, beach renourishment, beach cleaning, artificial lighting, predation, and poaching (NMFS & FWS 1991).

As discussed previously, the survival of juvenile loggerhead sea turtles is threatened by a completely different set of threats from human activity once they migrate to the ocean. Pelagic immature loggerhead sea turtles from these four subpopulations circumnavigate the North

Atlantic over several years (Carr 1987, Bjorndal 1994). During that period, they are exposed to a series of long-line fisheries that include an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al*., 1995, Bolten *et al.*, 1994, Crouse 1999). Based on their proportional distribution, the capture of immature loggerhead sea turtles in long-line fleets in the Azores and Madiera Archipelagoes and the Mediterranean Sea will have a significant, adverse effect on the annual survival rates of juvenile loggerhead sea turtles from the western Atlantic subpopulations, with a disproportionately large effect on the northern subpopulation that may be significant at the population level.

In waters off coastal U.S., a suite of fisheries in Federal and State waters threatens the survival of juvenile loggerhead sea turtles. Loggerhead turtles are captured, injured, or killed in shrimp fisheries off the Atlantic coast; along the southeastern Atlantic coast, loggerhead turtle populations are declining where shrimp fishing is intense off the nesting beaches (NRC 1990). Conversely these nesting populations do not appear to be declining where nearshore shrimping effort is low or absent. The management of shrimp harvest in the Gulf of Mexico demonstrates the correlation between shrimp trawling and impacts to sea turtles. Waters out to 200nm are closed to shrimp fishing off of Texas each year for approximately a three-month period (mid-May through mid-July) to allow shrimp to migrate out of estuarine waters; sea turtle strandings decline dramatically during this period (NMFS, STSSN unpublished data). Loggerhead sea turtles are captured in fixed pound-net gear in the Long Island Sound, in pound-net gear and trawls in summer flounder and other finfish fisheries in the mid-Atlantic and Chesapeake Bay, in gill net fisheries in the mid-Atlantic and elsewhere, in fisheries for monkfish and for spiny dogfish, and in northeast sink gillnet fisheries (see further discussion in the *Environmental Baseline* of this Opinion). Witzell (1999) compiled data on capture rates of loggerhead and leatherback turtles in U.S. longline fisheries in the Caribbean and northwest Atlantic; the cumulative takes of these fisheries approach those of the U.S. shrimp fishing fleet (Crouse 1999, NRC 1990).

Hawksbill Turtle

Hawksbill turtles are small to medium-sized sea turtles. They are distinguished from other sea turtles by two pairs of prefrontal scales; thick carapace scutes that overlap towards the turtle's posterior, four pairs of costal scutes; and two claws on each flipper. There are two recognized subspecies of hawksbill sea turtles, one in the Atlantic Ocean (ssp. *imbricata*) and one in the Pacific Ocean (ssp. *squamata*).

Hawksbill turtles use different habitats for different stages in their life cycles. Post-hatchling hawksbill turtles remain in pelagic environments to take shelter in weedlines that accumulate at convergence points. Juvenile hawksbill turtles (those with carapace lengths of 20-25 cm) re-enter coastal waters where they become residents of coral reefs, which provide sponges for food and ledges, and caves for shelter. Hawksbill turtles are also found around rocky outcrops, high-energy shoals, and mangrove-fringed bays and estuaries (particularly in areas where coral reefs do not occur). Hawksbill turtles remain in coastal waters when they become subadults and adults.

Hawksbill turtles occur in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. In the United States, hawksbill sea turtles have been recorded in all states along the Gulf of Mexico and along the Atlantic coast to Massachusetts. In the United States, hawksbill turtles nest on the Atlantic coast of Florida, the U.S. Virgin Islands, and Puerto Rico. Hawksbill turtles nests in Florida are relatively rare, but Richardson *et al*. (1989) estimated that the Caribbean and Atlantic portions of the U.S. support a minimum of 650 hawksbill turtle nests each year

The hawksbill turtle was listed as an endangered species on June 2, 1970 (35 FR 8491). The hawksbill turtle has been endangered by significant modifications of its coastal habitat throughout its range. The National Research Council (1990), and NMFS/FWS (1993) have published general overviews of the effects of habitat alteration on hawksbill turtles. In the U.S. Virgin Islands, problems such as egg poaching, domestic animals, beach driving, litter, and recreational use of beaches have presented problems for nesting hawksbill turtles. In addition, beachfront lights appear to pose a serious problem for hatchling hawksbill (and other) turtles in the U.S. Virgin Islands. At sea, activities that damage coral reefs and other habitats that are important to the hawksbill turtle threaten the continued existence of this species. Hawksbill turtles are also threatened by natural causes including hurricanes and predation by exotic species (fire ants, raccoons (*Procyon lotor*) and opossums (*Didelphus virginiana*)) and by poaching of eggs and nesting females.

In 1998, NMFS designated the waters surrounding Mona and Monito Islands, Puerto Rico as critical habitat for the hawksbill turtle.

Kemp's Ridley Sea Turtle

Of the seven extant species of sea turtles of the world, the Kemp's ridley has declined to the lowest population level. The Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempi*) (USFWS and NMFS 1992) contains a description of the natural history, taxonomy, and distribution of the Kemp's ridley turtle. Kemp's ridleys nest in daytime aggregations known as arribadas. The primarily arribada in the Gulf of Mexico is located at Rancho Nuevo, a stretch of beach in Mexico. Most of the population of adult females nest in this single locality (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the early 1970's, the world population estimate of mature female Kemp's ridleys had been reduced to 2,500-5,000 individuals. The population declined further through the mid-1980s. Recent observations of increased nesting suggest that the decline in the ridley population has stopped and there is cautious optimism that the population is now increasing.

Research being conducted by Texas A&M University has resulted in the intentional live-capture of hundreds of Kemp's ridleys at Sabine Pass and the entrance to Galveston Bay. Between 1989 and 1993, 50 of these turtles were tracked (using satellite and radio telemetry) by biologists with the NMFS Galveston Laboratory. The tracking study was designed to characterize sea turtle habitat and to identify small and large-scale migration patterns. Preliminary analysis of the data collected during these studies suggests that subadult Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, NMFS Galveston Laboratory, pers. comm.).

After unprecedented numbers of Kemp's ridley carcasses were reported from Texas and Louisiana beaches during periods of high levels of shrimping effort, NMFS established a team of population biologists, sea turtle scientists, and managers, known as the Turtle Expert Working Group (TEWG) to conduct a status assessment of sea turtle populations. Analyses conducted by the group have indicated that the Kemp's ridley population is in the early stages of recovery; however, strandings in some years have increased at rates higher than the rate of increase in the Kemp's population (TEWG 1998). While many of the stranded turtles observed in recent years in Texas and Louisiana are believed to have been incidentally taken in the shrimp fishery, other sources of mortality exist in these waters. These stranding events illustrate the vulnerability of Kemp's ridley and loggerhead turtles to the impacts of human activities in nearshore Gulf of Mexico waters.

The TEWG (1998) developed a population model to evaluate trends in the Kemp's ridley population through the application of empirical data and life history parameter estimates chosen by the TEWG. Model results identified three trends in benthic immature Kemp's ridleys. Benthic immatures are those turtles that are not yet reproductively mature but have recruited to feed in the nearshore benthic environment where they are available to nearshore mortality sources that often result in strandings. Benthic immature ridleys are estimated to be 2-9 years of age and 20-60 cm in length. Increased production of hatchlings from the nesting beach beginning in 1966 resulted in an increase in benthic ridleys that leveled off in the late 1970s. A second period of increase followed by leveling occurred between 1978 and 1989 as hatchling production was further enhanced by the cooperative program between the U.S. Fish and Wildlife Service (FWS) and Mexico's Instituto Nacional de Pesca to increase the nest protection and relocation program in 1978. A third period of steady increase, which has not leveled off to date, has occurred since 1990 and appears to be due to the greatly increased hatchling production and an apparent increase in survival rates of immature turtles beginning in 1990 due, in part, to the introduction of turtle excluder devices (TEDs). Adult ridley numbers have now grown from a low of approximately 1,050 adults producing 702 nests in 1985, to greater than 3,000 adults producing 1,940 nests in 1995 and about 3,400 nests in 1999.

The TEWG (1998) was unable to estimate the total population size and current mortality rates for the Kemp's ridley population. However, the TEWG listed a number of preliminary conclusions. The TEWG indicated that the Kemp's ridley population appears to be in the early stage of exponential expansion. Over the period 1987 to 1995, the rate of increase in the annual number of nests accelerated in a trend that would continue with enhanced hatchling production and the use of TEDs. Nesting data indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and a low of 702 nests in 1985. This trajectory of adult abundance tracks with trends in nest abundance from an estimate of 9,600 in 1966 to 1,050 in 1985. The TEWG estimated that in 1995 there were 3,000 adult ridleys. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6% to 28% from 1981 to 1989 and from 23% to 41% from 1990 to 1994. The population model in the TEWG projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan of 10,000 nesters by the year 2020 if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. It determined that the data reviewed suggested that adult Kemp's ridley turtles were restricted somewhat to the Gulf of Mexico in shallow near shore waters, and benthic immature turtles of 20-60 cm straight line carapace length are found in nearshore coastal waters including estuaries of the Gulf of Mexico and the

Atlantic.

The TEWG (1998) identified an average Kemp's ridley population growth rate of 13% per year between 1991 and 1995. Total nest numbers have continued to increase. However, the 1996 and 1997 nest numbers reflected a slower rate of growth, while the increase in the 1998 nesting level has been much higher and decreased in 1999. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

The area surveyed for ridley nests in Mexico was expanded in 1990 due to destruction of the primary nesting beach by Hurricane Gilbert. The TEWG (1998) assumed that the increased nesting observed particularly since 1990 was a true increase, rather than the result of expanded beach coverage. Because systematic surveys of the adjacent beaches were not conducted prior to 1990, there is no way to determine what proportion of the nesting increase documented since that time is due to the increased survey effort rather than an expanding ridley nesting range. As noted by TEWG, trends in Kemp's ridley nesting even on the Rancho Nuevo beaches alone suggest that recovery of this population has begun but continued caution is necessary to ensure recovery and to meet the goals identified in the Kemp's Ridley Recovery Plan.

Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Post-pelagic ridleys feed primarily on crabs, consuming a variety of species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* sp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal, 1997). Juvenile ridleys migrate south as water temperatures cool in fall, and are predominantly found in shallow coastal embayments along the Gulf Coast during fall and winter months.

Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 40 centimeters in carapace length, and weighing less than 20 kilograms (Klinger and Musick 1995). Next to loggerheads, they are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June, and migrating to more southerly waters from September to November (Keinath *et al.*, 1987; Musick and Limpus, 1997). In the Chesapeake Bay, ridleys frequently forage in shallow embayments, particularly in areas supporting submerged aquatic vegetation (Lutcavage and Musick, 1985; Bellmund *et al.*, 1987; Keinath *et al.*, 1987; Musick and Limpus, 1997). The juvenile population in Chesapeake Bay is estimated to be 211 to 1,083 turtles (Musick and Limpus, 1997).

General human impacts and entanglement

Anthropogenic impacts to the Kemp's ridley population are similar to those discussed above. Sea sampling coverage in the northeast otter trawl fishery, pelagic longline fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. As with loggerheads, a large number of Kemp's ridleys are taken in the southeast shrimp fishery each year. Kemp's ridleys were also affected by the apparent large-mesh gillnet interaction that occurred in spring off of North Carolina. A total of five carcasses were recovered from the same North Carolina beaches where 277 loggerhead carcasses were found. This is expected to be a

minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all carcasses washed ashore.
Johnson's seagrass

Smalltooth Sawfish
All modern sawfish belong to the Suborder Pristoidea, Family Pristidae, and Genus *Pristis*. Although they are rays, sawfish appear to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. The snout of all sawfish is extended as a long narrow flattened rostral blade with a series of transverse teeth along either edge, hence the vernacular name. Species in the genus *Pristis* are separable into two groups according to whether the caudal fin has a distinct lower lobe or not. The smalltooth sawfish, *Pristis pectinata*, is the sole known representative on the western side of the Atlantic of the group lacking a defined lower caudal lobe (NMFS, 2000).

Distribution
The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In U.S. waters, *P. pectinata* historically occurred from North Carolina south through the Gulf of Mexico, where it was sympatric with the largetooth sawfish (west and south of Port Arthur, TX) (Adams and Wilson, 1995). It also was an occasional visitor to waters as far north as New York. As with all sawfishes, it is euryhaline, occurring in fresh water, nearshore estuaries and in coastal waters to depths of 25 meters.

Pristis pectinata is the largest of the sawfishes, reported to reach 760 cm while more commonly growing to 550 cm (Last and Stevens 1994). Bigelow and Schroeder (1953) reported litter size of 15-20 embryos. Overall, life history parameters for this species are largely unknown.

In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters. Records indicate that smalltooth sawfish have been found in the lower reaches of the St. Johns River and the Indian River lagoonal system. Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months.

Updated collection records from the Florida Museum of Natural History of the University of Florida include 13 records of *P. pectinata* from 1912 to 1998 (with one record not dated). Nine of these specimens were recorded from the Gulf of Mexico off Florida, three came from the Atlantic side of Florida, and one animal was caught in Pacific waters off Ecuador. Three additional records of smalltooth sawfish from the Atlantic coast of Florida have yet to be cataloged in this collection: one specimen is from 1979; the second is not dated (the Museum received both these fish from the Harbor Branch Oceanographic Institute); a third specimen was landed May 22, 1998 from the Indian River (Burgess, pers. comm.). There are eight reports of smalltooth sawfish along the Florida east coast in the 1990's, most from coastal rather than lagoonal areas.

General Human-related impacts
The principal habitats for smalltooth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder,

1953). The continued urbanization of the southeastern coastal states has resulted in substantial loss of coastal habitat through such activities as agricultural and urban development; commercial activities; dredge and fill operations; boating; erosion and diversions of freshwater run-off (SAFMC, 1998). Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. With the K-selected life history strategy of smalltooth sawfish, including slow growth, late maturation, and low fecundity, long-term commitments to habitat protection are necessary for the eventual recovery of the species.

A complete review of the factors contributing to the decline of the smalltooth sawfish can be found in the "Status Review of Smalltooth Sawfish (*Pristis pectinata*)", (NMFS, 2000) and will not be repeated in detail here.

Status and Trends of smalltooth sawfish

The smalltooth sawfish was added to the list of species as candidates under the ESA in 1991, removed in 1997, and placed back on the list again in 1999. In November 1999, NMFS received a petition from the Center of Marine Conservation requesting that this species be listed as endangered under the ESA. NMFS completed a status review for smalltooth sawfish in December 2000, and published a proposed rule to list this the U.S. population of this species as endangered under the ESA on April 16, 2001. On April 1, 2003, the National Marine Fisheries Service (NOAA Fisheries) announced its final determination to list smalltooth sawfish as an endangered species under the Endangered Species Act (ESA).

According to NMFS (2000) "The U.S. DPS of smalltooth sawfish has experienced a ninety percent curtailment of its range and severe declines in abundance. Agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off have resulted in the destruction and modification of smalltooth habitat throughout the southeastern U.S. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor. Over 50% of the U.S. human population lives within fifty miles of the ocean or Great Lakes. Migration to the coastlines for home, livelihood or recreation is predicted to increase by the year 2010 (National Ocean Service, 2000). Increases in coastal human populations will likely result in additional losses of marine habitats and increased pollution, further threatening the survival of smalltooth sawfish."

Simpfendorfer (2000) used a demographic approach to estimate intrinsic rate of natural increase and population doubling time. Since there are very limited life history data for smalltooth sawfish, much of the data (e.g. reproductive periodicity, longevity and age-at-maturity) were inferred from the more well-known largetooth sawfish. The litter size of smalltooth sawfish in the literature is given as 15 – 20 and Simpfendorfer used a mean of 17.5. However, the data on which this litter size is based are somewhat dubious. To account for uncertainty in the life-history parameters several different scenarios were tested, covering longevities from 30 to 70 years and ages-at-maturity from 10 to 27 years. The results indicated that the intrinsic rate of population increase ranged from 0.08/year to 0.13/ year, and population-doubling times ranged from 5.4 years to 8.5 years. These models assume the literature value for litter size is correct; doubling times would be longer if litter sizes are more in the range observed for largetooth sawfish (1 to 13, with a mean of 7.3). Simpfendorfer concluded:

> The estimated population doubling times for smalltooth sawfish indicate that the recovery times for this population will be very long. There are no data available on the size of the remaining populations, but anecdotal information indicates that smalltooth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. Fragmenting of the population will increase the time that it takes for recovery since the demographic models used in the study above assume a single inter-breeding population. The genetic effects of recovery from very small population sizes may also impact conservation efforts. It is likely that even if an effective conservation plan can be introduced in the near future, recovery to a level where the risk of extinction is low will take decades, while recovery to pre-European settlement levels would probably take several centuries.

Johnson's Seagrass

Species Description

Johnson's seagrass was listed as threatened under the ESA on September 14, 1998 based on the results of fieldwork and a status review initiated in 1990 and is the first marine plant ever listed. Kenworthy (1993, 1997, 1999) discusses the results of the field studies and summarizes an extensive literature review and associated interviews regarding the status of Johnson's seagrass.

The species has only been found growing along approximately 200 km of coastline in southeastern Florida from Sebastian Inlet, Indian River County to northern Key Biscayne. This narrow range and apparent endemism indicates that Johnson's seagrass has the most limited geographic distribution of any seagrass in the world.

Johnson's seagrass occurs in dynamic and disjunct patches throughout its range. Growth appears to be rapid and leaf pairs have short life spans while horizontally spreading from dense apical meristems (Kenworthy 1997). Kenworthy suggested that horizontal spreading rapid growth pattern and a high biomass turnover could explain the dynamic patches observed in distribution studies. New information reviewed in Kenworthy (1999, 1997) confirms *H. johnsonii's* limited geographic distribution in patchy and vertically disjunct areas between Sebastian Inlet and northern Biscayne Bay. Surveys conducted by NMFS and Florida staff in Biscayne Bay, Florida Bay, the Florida Keys, outer Florida Bay, Puerto Rico, and the Virgin Islands provided no verifiable sightings of Johnson's seagrass outside of the range already reported.

<u>Extent of critical habitat:</u>

The northern and southern ranges of Johnson's seagrass are defined as Sebastian Inlet and central Biscayne Bay, respectively. These limits to the species' range have been designated as critical habitat for Johnson's seagrass. Within its range, Johnson's seagrass critical habitat designations have been designated for 10 areas: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. There is no designated critical habitat within the action area.

Life History

Reproductive strategy

The species is perennial and may spread even during winter months under favorable conditions (Virnstein *et al.* 1997). Sexual reproduction in Johnson's seagrass has not been documented. Female flowers have been found; however, dedicated surveys in the Indian River Lagoon have not discovered male flowers, fertilized ovaries, fruits, or seeds either in the field or under laboratory conditions (Jewett-Smith *et al.* 1997). Searches throughout the range of Johnson's seagrass have produced the same results, suggesting that the species does not reproduce sexually or that the male flowers are difficult to observer or describe, as noted for other *Halophila* species (Kenworthy 1997). Surveys to date indicate that the incidence of female flowers appears to be much higher near the inlets leading to the Atlantic Ocean, suggesting that inlet conditions are qualitatively better for flowering than conditions further inshore (Kenworthy pers. comm. 1998). It is possible that male flowers, if they exist, occur near inlets as well. Maintenance of good water quality around inlets may be essential for promoting flowering in the Johnson's seagrass population.

Niche

The essential features of habitat appear to be adequate water quality, salinity, water clarity and stable sediments free from physical disturbance. Important habitat characteristics include shallow intertidal as well as deeper subtidal zones (2-5 m). Water transparency appears to be critical for Johnson's seagrass, limiting its distribution at depth to areas of suitable optical water quality (Kenworthy 1997). In areas in which long-term poor water and sediment quality have existed until recently, such as Lake Worth Lagoon, *H. johnsonii* appears to occur in relatively higher abundance perhaps due to the previous inability of the larger species to thrive. These studies support unconfirmed previous observations that suspended solids and tannin, which reduce light penetration and water clarity, may be important factors limiting seagrass distribution. Good water clarity is essential for *Halophila johnsonii* growth in deeper waters.

Johnson's seagrass occurs over varied depths, environmental conditions, salinities, and water quality. In tidal channels *H. johnsonii* is found in coarse sand substrates, although it has been found growing on sandy shoals, in soft mud near canals and rivers where salinity many fluctuate widely (Virnstein *et al.* 1997). Virnstein has called Johnson's seagrass a "perennial opportunistic species." Within his study areas in the Indian River Lagoon, *H. johnsonii* was found by itself, with other seagrass species, in the intertidal, and (more commonly) at the deep edge of some transects in water depths of up to 180 cm. *H. johnsonii* was found shallowly rooted on sandy shoals, in soft mud, near the mouths of canals, rivers and in shallow and deep water (Virnstein *et al.* 1997). Additionally, recent studies have documented large patches of Johnson's seagrass on flood deltas just inside Sebastian Inlet, as well as far from the influence of inlets (reported at the workshop discussed in Kenworthy, 1997). These sites encompass a wide variety of salinities, water quality, and substrates.

Competitors:

Halophila johnsonii appears to be outcompeted in ideal seagrass habitats where environmental conditions permit the larger species to thrive (Virnstein *et al.* 1997, Kenworthy 1997).

Population Dynamics
Population stability
A factor leading to the listing of *H. johnsonii* is its rareness within its extremely restricted geographic range. Johnson's seagrass is characterized by small size (it is the smallest of all of the seagrasses found within its range, averaging about 3 cm in height), fragile rhizome structure and associated high turnover rate, and is apparently reliant on vegetative means to reproduce, grow and migrate across the sea bottom. These factors make Johnson's seagrass extremely vulnerable to human or environmental impacts by reducing its capacity to repopulate an area once removed. The species and its habitat are impacted by human-related activities throughout the length its range, including bridge construction and dredging, and the species' threatened status produces new and unique challenges for the management of shallow submerged lands. Vessel traffic resulting in propeller and anchor damage, maintenance dredging, dock and marine construction, water pollution, and land use practices could require special management within critical habitat.

Population (genetic) variability:
The Boca Raton and Boynton Beach sites proposed for critical habitat designation have populations that are distinguished by a higher index of genetic variation than any of the central and northern populations examined to date (Kenworthy, 1999). These two sites represent a genetically semi-isolated group that could be the reservoir of a large part of the overall genetic variation found in the species. Information is still lacking on the geographic extent of this genetic variability.

Status and Distribution
Kenworthy (1997, 1999) summarized the newest information on Johnson's seagrass biology, distribution, and abundance and confirmed the limited range and rareness of this species within its range. Additionally, the apparent restriction of propagation through vegetative means suggests that colonization between broadly disjunct areas is likely difficult, suggesting that the species is vulnerable to becoming endangered if it is removed from large areas within its range by natural or anthropogenic means. Human impacts to Johnson's seagrass and its habitat include: (1) Vessel traffic and the resulting propeller dredging and anchor mooring; (2) dredging; (3) dock and marina construction and shading from these structures; (4) water pollution; and (5) land use practices including shoreline development, agriculture, and aquaculture.

Activities associated with recreational boat traffic account for the majority of human use associated with the proposed critical habitat areas. The destruction of the benthic community due to boating activities, propeller dredging, anchor mooring, and dock and marina construction was observed at all sites during a study by NMFS from 1990 to 1992. These activities severely disrupt the benthic habitat, breaching root systems, severing rhizomes, and significantly reducing the viability of the seagrass community. Propeller dredging and anchor mooring in shallow areas are a major disturbance to even the most robust seagrasses. This destruction is expected to worsen with the predicted increase in boating activity. Trampling of seagrass beds, a secondary effect of recreational boating, also disturbs seagrass habitat. Populations of Johnson's seagrass inhabiting shallow water and water close to inlets, where vessel traffic is concentrated, will be most affected.

The constant sedimentation patterns in and around inlets require frequent maintenance dredging, which could either directly remove essential seagrass habitat or indirectly affect it by redistributing sediments, burying plants and destabilizing the bottom structure. Altering benthic topography or burying the plants may remove them from the photic zone. Permitted dredging of channels, basins, and other in- and on-water construction projects cause loss of Johnson’s seagrass and its habitat through direct removal of the plant, fragmentation of habitat, and shading. Docking facilities that, upon meeting certain provisions, are exempt from state permitting also contribute to loss of Johnson’s seagrass through construction impacts and shading. Fixed add-ons to exempt docks (such as finger piers, floating docks, or boat lifts) have recently been documented as an additional source of seagrass loss due to shading (Smith and Mezich, 1999).

Decreased water transparency caused by suspended sediments, water color, and chlorophylls could have significant detrimental effects on the distribution and abundance of the deeper water populations of Johnson's seagrass. A distribution survey in Hobe and Jupiter Sounds indicates that the abundance of this seagrass diminishes in the more turbid interior portion of the lagoon where reduced light limits photosynthesis.

Other areas of concern include seagrass beds located in proximity to rivers and canal mouths where low salinity, highly colored water is discharged. Freshwater discharge into areas adjacent to seagrass beds may provoke physiological stress upon the plants by reducing the salinity levels. Additionally, colored waters released into these areas reduce the amount of sunlight available for photosynthesis by rapidly attenuating shorter wavelengths of Photosynthetically Active Radiation.

Continuing and increasing degradation of water quality due to increased land use and water management threatens the welfare of seagrass communities. Nutrient overenrichment caused by inorganic and organic nitrogen and phosphorous loading via urban and agricultural land run-off stimulates increased algal growth that may smother Johnson's seagrass, shade rooted vegetation, and diminish the oxygen content of the water. Low oxygen conditions have a demonstrated negative impact on seagrasses and associated communities.

A wide range of activities funded, authorized or carried out by Federal agencies may affect the essential habitat requirements of Johnson's seagrass. These include authorization by the COE for beach nourishment, dredging, and related activities including construction of docks and marinas; bridge construction projects funded by the Federal Highway Administration; actions by the U.S. Environmental Protection Agency and the COE to manage freshwater discharges into waterways; regulation of vessel traffic by the U.S. Coast Guard; management of national refuges and protected species by the U.S. Fish and Wildlife Service; management of vessel traffic (and other activities) by the U.S. Navy; authorization of state coastal zone management plans by NOAA's National Ocean Service, and management of commercial fishing and protected species by NMFS.

<u>Rangewide trend</u>:
Lamentably, there is currently insufficient information to clearly determine trends in the

Johnson's seagrass population, which was described in 1980 and has only been extensively studied during the 1990s. Generally, seagrasses within the range of Johnson's seagrass have declined in some areas and increased in others. Where multiyear mapping studies have been conducted within the Indian River Lagoon, recent increases in Johnson's seagrass have been noted but may be attributed in part to the recent increase in search effort and increased familiarity with this species (Virnstein *et al.* 1997). The authors conclude that from 1994 through 1997, no strong seasonal distribution or increases or decreases in abundance or range can be discerned.

Protected Species Surveys within the project area.

Surveys specifically targeting protected species were not conducted in the action area, however an Environmental Baseline Study and Impact Assessment were prepared. This assessment, literature reviews and consultations with NMFS serve as the basis for this biological assessment and the determination of which listed and protected species under NMFS' jurisdiction are found in the project area.

Sea Turtles

Broward County is within the normal nesting range of three species of sea turtles: the loggerhead (*Caretta caretta*), the green turtle (*Chelonia mydas*), and the leatherback (*Dermochelys coriacea*). The green sea turtle and leatherback sea turtle are both listed under the U. S. Endangered Species Act, 1973 and Chapter 370, F.S. The loggerhead turtle is listed as a threatened species (Burney and Margolis, 1999). Within the 38.6 miles of beach from the Palm Beach County line to the Dade County line a total of 2,620 sea turtle nests were found in 1999 (Burney and Margolis 1999). From 1990 through 1999, an average of 2,446 sea turtle nests were discovered on Broward County beaches. Within John U. Lloyd SRA, a total of 212 sea turtle nests were observed during 1999 (DC&A, 2002). The majority of sea turtle nesting activity occurred during the summer months of June, July and August, with nesting activity occurring as early as March and as late as September (Burney and Margolis, 1999). The waters offshore of Broward County are also habitat used for foraging and shelter for the three species listed above and possibly the hawksbill turtle (*Eretmochelys imbricata*), and the Kemp's ridley turtle (*Lepidochelys kempii*) (USACE, 2000).

Six (6) stranded threatened and endangered sea turtles have been reported within the Port boundaries: 3 loggerheads, 2 green turtles and 1 hawksbill. In addition there were 13 incidental capture records - 1 green turtle was caught on hook and line and 12 turtles (6 loggerheads, 2 green turtles, 2 hawksbills and 2 unidentified species) were caught in the power plant at Port Everglades (Wendy Teas, pers. Comm. 2002).

Johnson's Seagrass

Johnson's seagrass occurs within the project area, specifically in the Intracoastal Waterway east and south of the Main Turning Basin, and just west of the Dania Cutoff Canal, and in the Dania Cutoff Canal. Abundance and density values are low and the species is generally associated with *H. decipiens*. Johnson's seagrass also occurs south of the Dania Cutoff Canal within Whiskey Creek, along the western shore of the Intracoastal Waterway and within the West Lake Park embayment (Miller Legg, 2001). Cover-abundance and density were higher along the west shore of West Lake Park than was observed within the Port Everglades project area.

Smalltooth sawfish

This species inhabits softbottom estuarine habitats in depths generally less than 30 feet. Its former range in U.S. waters extended from Texas through Maryland. Currently, few are observed outside peninsular Florida. At least one recorded observation has occurred within the vicinity of Broward County (NMFS, 2000). Populations likely decreased due to a low intrinsic rate of natural increase, the long interval to time of reproduction, and human impacts, most notably overfishing, incidental take in nets (due in part to its body size and unusual morphology), and habitat loss (development of shoreline and nearshore habitats).

Effects of the Action on Protected Species.

As previously stated, the Corps believes that the loggerhead turtle, green turtle, smalltooth sawfish and johnson's seagrass have the potential to be effected by the proposed dredging project. The project may have the following adverse impacts on listed/protected species are:

- direct effect of blasting in the turning basin.
- direct effect of dredging activities
- indirect effects

Direct Effects

Blasting

To assess and reduce the effects of blasting on endangered, threatened and otherwise protected species, the Corps contracted with Dr. Calvin Koyna, Precision Blasting Services to review previous Corps blasting projects, recommendations of Florida Fish and Wildlife Conservation Commission (FFWCC) (then known as the Florida Department of Natural Resources) and the U.S. Fish and Wildlife Service (FWS) prepared for a harbor deepening project at Port Everglades, Florida conducted in the mid 1980's. The recommendations prepared for the project were specifically aimed at protecting endangered manatees and endangered/threatened sea turtles.

Sea turtles

Specific information regarding the likely direct impact of explosives on sea turtles is not available. Studies regarding the impacts of relatively minuscule explosives on humans noted that minor injuries such as small bruises or perforations of the intestinal tract occasionally occur well beyond ranges in which human lung damage could occur (Christian and Gaspin, 1974). Christian and Gaspin (1974) note that these minor injuries could become serious if left unattended. Sea turtles with untreated internal injuries would have increased vulnerability to predators and disease. In the Environmental Impact Statement prepared by the Navy to consider the effects of explosives used in shipshock tests, nervous system damage was cited as a possible impact to sea turtles caused by blasting. Damage of the nervous system could kill sea turtles through disorientation and subsequent drowning. The Navy's review of previous studies suggested that rigid masses such as bone (or carapace and plastron) could protect tissues beneath them; however, there are no observations available to determine whether the turtles' shells would indeed afford such protection.

Studies conducted by Klima *et al*., (1988) evaluated blasts of only approximately 42 lbs on sea turtles (4 ridleys, 4 loggerheads) placed in surface cages at varying distances from the explosion. Christian and Gaspin's (1974) estimates of safety zones for swimmers found that, beyond a cavitation area, waves reflected off a surface have reduced pressure pulses; therefore, an animal at shallow depths would be exposed to a reduced impulse. This finding, which considered only very small explosive weights, implies that the turtles in the Klima *et al*. (1988) study would be under reduced effects of the shock wave. Despite this possible lowered level of impact, 5 of 8 turtles were rendered unconscious at distances of 229 to 915 m from the detonation site. Unconscious sea turtles that are not detected, removed and rehabilitated likely have low survival rates.

Blasting will affect nearby finfish and invertebrates and cause short-term changes to the physical characteristics of the benthos. Fish and invertebrates killed or injured by the blasting may provide a short-term enhancement of foraging opportunities for green and loggerhead sea turtles. Through new recruitment and local migrations, finfish and benthic invertebrates are expected eventually to repopulate the affected area. Any modifications of the local area's environment, as far as sea turtle habitat, are not expected to be significant in the long term.

<u>Smalltooth Sawfish</u>
Blasting rock underwater produces a pressure wave in water that can produce fish mortality. Different types of fish have different mortality thresholds. This depends on whether the fish dwell near the surface, on the bottom, or in between.

The magnitude of the pressure wave generated in greatly affected by the stemming of the blastholes, distance between holes, and the delay time of the holes.

Normally, mortality occurs in the range of 150-psi overpressure for fish. In practice this is a 75-foot to 100-foot radius around the blasting area.

Dredging
<u>Sea Turtles</u>
The effects of hopper dredging on sea turtles on the Atlantic coast were analyzed by NMFS in the 1997 biological opinion entitled "The continued hopper dredging of channels and borrow areas in the southeastern United States". If it is determined that a hopper dredge will be used, the Terms and Conditions of this opinion will be applied to the project. If a cutterhead or clamshell dredge is used, based on a finding in the November 25, 1991 biological opinion between NMFS and the Corps that states:

> "Pipeline dredges are relatively stationary and only influence small areas at any given time. For a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead and be caught in the suction. This type of behavior would appear unlikely, but may be possible. Presently, NMFS has determined that pipeline dredges are unlikely to adversely effect sea turtles".

Based on this determination, the Corps finds that use of a cutterhead dredge may effect, but is not likely to adversely affect sea turtles. If a clamshell dredge is used, there is no suction to capture a sea turtle and the turtle would have to be caught between the two halved of the clamshell. While this is not impossible, it is improbable. The Corps has also determined that use of a clamshell dredge may effect, but is not likely to adversely affect sea turtles.

Smalltooth sawfish

The smalltooth sawfish may be affected through dredging nearshore areas in channels that are currently suitable habitats (areas of sand and/or mud bottoms less than 30 feet in depth) and by blasting if there is an animal present in the blast zone at time of detonations.

Johnson's Seagrass

Dredging will result in the removal of approximately 1.79 acres of seagrass beds where *H. johnsonii* is the sole constituent or associate of other seagrass species in the Intracoastal Waterway and Dania Cutoff Canal. This impact will include the direct removal of *H. johnsonii*. Changes in bottom depth through deepening and widening efforts within the Port is expected to make resulting habitats unsuitable for re-colonization of *H. johnsonii*. It is not known if *H. johnsonii* in areas adjacent to dredging zones would be resilient to changes in water quality or to impacts resulting from deposition of sediments on blades.

Indirect Effects

Sea Turtles

Since beaches of John U. Lloyd SRA provide important nesting areas for three sea turtle species, the project area comprises important resources for turtles. Removal of sections of hardbottom, reef, and seagrass habitats will eliminate potential foraging habitat for juvenile sea turtles. The reduction in such habitat may slightly decrease the carrying capacity of the region for turtles. Also, since these habitats are also utilized as refugia for hatchling turtles, an increase in predation may be anticipated. Finally, dredge activities and associated disturbances (noise, lights, etc.) offshore may interrupt the movement of turtles swimming toward or away from nesting beaches. In fact, the highest potential impact to sea turtles may be the use of explosives to remove areas of rock within the Entrance and Southport Access Channels. It is extremely likely that both the pressure and noise associated with blasting will physically damage sensory mechanisms and other physiological functions of individual sea turtles.

Dolphins

Dredging and construction activities in the area may alter behavior and migration routes of dolphins. Any disturbance of dolphins would be considered harassment of a marine mammal under the Marine Mammal Protection Act of 1972.

Effect Determination

The Corps has determined that the proposed expansion of Port Everglades may adversely affect listed and proposed species within the action area and requests initiation of formal consultation with NMFS.

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NMFS – Southeast Regional Office – Port Everglades Feasibility Study

ESA Consultation – Status, review and future plans April 28, 2008

*** Meeting Recorded on iPod for the record in addition to meeting notes 11am – 230pm

Attendees

- Kenneth Dugger - USACE
- Martha Robbart - Dial Cordy and Associates
- Terri Jordan - USACE
- Bob Hoffman – NMFS-PRD
- Audra Livergood – NMFS-PRD
- David Bernhart – NMFS-PRD

Agenda

1. Review Benthic Assessment – Martha. Power point will be posted o USACE FTP site with meeting notes when finalized.
2. Discussions
    a. Adequacy of the existing USACE coral survey
    b. Scope of the proposed action
    c. BO timing
    d. Possibility of conferencing on coral CH and what that entails.

Results

1. Martha presented an overview of the existing USACE Reef Survey that was conducted in March 2006 (methods), and the subsequent findings published in the Reef Report (Dial Cordy 2008).
    a. 150-m indirect impact buffer calculations based on Key West (2004-2006); Key West 2007; Broward County Shore Protection Project and the Port Everglades 1980-81 dredging monitoring reports.
    b. Hopper dredges used in Key West and Broward County; cutterhead used at Port Everglades. Hopper dredges have higher turbidity than cutterheads due to overflow.
    c. Review of towed video (2000, 2001 and 2002) and diver video (2006) collected for the project.
    d. Diver safety is a limiting factor in active Navigation channels.
    e. NMFS Interim *Acropora* protocol – 2 scales – small projects <.25 acres or large projects >.25 acres. For USACE to survey the 20 minute timed swim for all of the 106 acres (.43 sq kms) – 430, 000 sq meters = 430 survey sites. Assuming you can perform 5-10 survey lines a day (an active shipping channel greatly limits access) = 9-17 work weeks with perfect weather for just *Acropora* surveys – not including any other hardbottom

characterization efforts that would be needed for the project. No current documentation protocol included in the existing protocol.

i. USACE Recommendations – Port Everglades is not only project with this problem. Miami, Key West, Palm Beach all have projects with scales greater than .25 acres. Key West did drift dives during the 2004-2006 and 2007 construction. USACE recommends that a towed-video survey method for the initial survey effort to identify presence absence. You can make scale as tight as you need it. After video is complete, if *Acropora* colonies are identified – then diver assessment can be performed o the identified colonies. The towed video also creates permanent record that any one can review (the DVD of the video). Restrict systems to digital GPS with coordinates on the video to ensure location data.

ii. NMFS recommends focusing *Acropora* survey effort on the nearshore ridge complex since we know this is suitable habitat for staghorn coral (e.g., JUL6). NMFS recommends the highest density of transects on the nearshore ridge complex, followed by the inner, middle, and outer reefs, respectively. Number of transects needed for a representative sample will need to be coordinated with other NMFS staff (Dr. Margaret Miller, Dr. Lisamarie Carrubba, and Jennifer Moore).

f. USACE survey was never intended to be an *Acropora* survey. It was designed to be a direct impact characterization in the 2nd and 3rd reefs only.

2. Discussions

a. Critical Habitat Designation – Port Everglades – all 106 acres of direct and indirect impacts = .005% of the proposed CH for the Florida Unit (8,000+ sq kms). This is a conservative number. It is based on the total of the Florida Unit – all habitats (sand, turf, etc) and the complete footprint of all habitats of the project area (previously impacted area, sand, turf, etc).

b. Ultimate goal – NMFS provides USACE with a biological opinion. NMFS major concern is having a preferred alternative. NMFS would prefer to not have to complete a Biop, and then go back and have to do another in a year or so. USACE must finish an EIS to finish Feasibility. That EIS must complete an ESA consultation, this is Corps regulation requirement. The ESA consultation is recommended to be in the Draft EIS, however it is required for the Final EIS. The ROD can not be signed without the ESA consult, thus the Feasibility Study can not be completed and submitted to Congress for authorization. NMFS would be more comfortable with waiting until the DEIS is released to the public before beginning the ESA consultation. USACE agrees that this is an acceptable method for the completion of the ESA consultation.

c. Mangrove removal from the Turning Notch and the effect on smalltooth sawfish. Blasting areas will include Main Turning Basin, South Turning Basin and Southport Access channel. USACE is using the same blasting protocol as used in Miami Harbor with confined blasts with stemming, and a specific number of observers. Those will all be included in the proposed action. The TN mangroves are mature. NMFS had some confusion with the TN impacts in 1989 and with the mitigation areas for the 89 TN dredging o the western edge of JUL (east side of SAC). No rip-rap breaks exist in the TN rip-rap. There are breaks at the JUL mangroves, but n breaks exist in the TN rip rap. There is tidal access from the northern side of the TN using a mosquito ditch. NMFS has requested that USACE put the Env. Friendly bulkhead with rip-rap in the TN and include breaks in the rip-rap to allow potential access by sawfish into the mangroves to the north of the TN that they currently have n access into.

d. USACE has committed to relocate corals greater than 12 inches in size from the direct impact areas. USACE has committed to relocate ANY *Acropora,* visible to the naked eye found in the direct impact area, without regard to size.

e. Planning, Engineering and Design Phase (referred to as "PED") *Acropora* survey – using the towed video survey would be performed on the 150-meter indirect effect area as well as the direct impact area. Discussions included the locations of JUL-6 and the presences of the *Acropora* there. Most of the *Acropora* that is prolific in Broward is being found o the nearshore ridge complex. For future survey and monitoring work – NMFS would like to see a focus on the nearshore ridge complex to ensure that any effects on *Acropora* near the channel are documented. Clarify what direct and indirect impacts are defined as by the USACE document. Direct impacts – physical removal of the habitat or the species. Indirect impacts – siltation and shading from dredge generated turbidity and sedimentation.

    i. In the 1980 dredging – there were monitoring stations on both sides of the channels. In the 1^{st} and 2^{nd} reef the currents run from North to South, beyond the 2^{nd} reef going to the 3^{rd} reef the currents are dominated by the Gulf Stream and the eddies generated from the Gulf Stream and move from south to North. In the 1980 dredging, with a cutterhead in the channel, with lower water quality standards than are in place today – no effect of the dredging was seen at any of the monitoring stations (north or south of the channel) as compared to baseline sites further from the channel. The 1980 report is available on the FTP site for review.

    ii. NMFS would like to review the 150-meter and determine if that is an appropriate for monitoring when we get to PED. The 150-m buffer is based on the four previous projects and those results. Other projects and monitoring for future projects will also feed into this process. NMFS would like to be part of the development of monitoring site locations for the pre, during and post phase.

This is where we are in Miami Harbor and NMFS will be involved extensively with that process and that process would be mimicked for Port Everglades. NMFS would also like to have monitoring sites with *A. cervicornis* present and include that information in the monitoring.

iii. Can the Entrance Channel dredging be completed during a time of year that will not expose the already stressed *Acropora* (stress associated with summer sun, still water and warm water) to turbidity and sedimentation? USACE recommended that NMFS include any window in the Biop Terms and Conditions that can then be incorporated into the Environmental Commitments section of the FEIS and the plans and specifications that the contractors would then bid against and be able to plan for. Previous Entrance channel dredging in 1980 was completed in 109 dredging days between 4 May and 27 December 1980. Weather, ship traffic and equipment will play huge role in how long it takes to complete this work. A window will increase dredging time since weather can drive the dredge inshore more often. NMFS may recommend a July – early September window, in which dredging would be prohibited or limited to specified locations away from coral, due to water temperature and still, calm water (high levels of UV light).

f. Review of the document – National Academy of Science will review Baseline reports (Reef, seagrass, mangroves, etc); DEIS. NAS review will begin after the scope is complete. The first phase will be baseline materials. Second phase will be the DEIS. An interim report on the science will be provided by the NAS. Lead coordinator for the NAS process is the Center of Expertise for Deep Draft Navigation (Mobile District). SAJ is coordinating with them and NAS.

g. Discussions of Miami Harbor pending surveys (summer/early fall 2008) with a consultation in the fall 2008. Miami is in PED. Port of Palm Beach is also pending ESA consultation.

h. Alternative 5 in the DEIS is the maximum impact. Cooperating agency staffs believe that they feel they can remove the flare in the entrance channel. USGC and pilots specifically document accidents, allisions and collisions in the Feasibility Study. The larger ships (post-panamax) ships have already been turned away from Port Everglades due to lack of entrance channel depth. Documentation of these requests has been provided to USACE by the pilots and the ports. Pilots requested a 1,000 ft wide entrance channel flare – the ship simulation documented a need for no more than an 800 ft wide flare. Discussions also included the ability to use tugs, etc. David Bernhart agreed with USACE analysis regarding speed needs entering Port Everglades – which is faster than a tug can catch the ship to bring them in under tug power. There is n way to reduce the flare beyond the 800ft width currently proposed when considering vessel safety as the primary consideration. If the 1,000 ft flare had been included in would have resulted in an additional 7.9 acres of reef impacts to the 2nd and 3rd reef.

i. Seagrass and mangrove mitigation discussion. Westlake Park construction of mitigation area to start in 200 – early mitigation as compared to impact proposed in 2012. 90% plans and specs being completed and getting ready to move forward with bidding to contractors which would allow construction to begin in 2009. Monitoring will be done by County to verify the success of mitigation efforts with reports to USACE/SFWMD/County.

Tasks/To Dos –

1. USACE will prepare a proposed draft protocol for using video as a baseline for *Acropora* surveys in large scale projects.

2. NMFS will review this protocol and make recommendations for change/accept the proposal for implementation (Audra/Margaret Miller/others). New protocol would be for four channels in Florida, five in Puerto Rico and two in the USVI. This may best be harbor/channel survey specific protocol. This would be technology based survey since humans in channels is a dangerous situation. Note: NMFS may recommend some in-water transects (by divers) outside of the channel in areas of potential indirect impact (from sedimentation and/or turbidity) that support hardbottom (i.e., areas that have the PCE for Acropora proposed critical habitat).

3. USACE will use DEIS, when released to the public, as the final item in the consultation initiation package. The DEIS will include a proposed action that USACE is consulting on and will include conservation/mitigation measures aimed at protected resources. Consultation will be based on what NMFS knows now and that proposed action.

    a. Breaks in rip rap bulkheads at TN to increase possible access for sawfish (also increased flushing for the mangroves).

    b. *Acropora* survey using video as the baseline in the PE&D phase of the project (2012 construction – 2009-2010 for PED assuming that there is WRDA 200 that would include Port Everglades – which may be a contingent authorization – however the report must be completed by the end of the calendar year. This would require FS and EIS to be completed by Dec 31, 2008. Not very likely).

    c. Monitoring sites for indirect effects from turbidity and sedimentation development of protocol and locations during PE&D phase.

    d. All blasting criteria used in Miami Harbor and lessons learned from Miami.

    e. NMFS-PRD can help write the mitigative measures with USACE for the DEIS under the cooperating agency agreement under CEQ NEPA regs.

4. NMFS will prepare a biological opinion (formal consultation) for the Port Everglades project.

    a. Will include final designated Critical Habitat in the Biop (expected to be final in Nov 2008, and Biop will likely be after the finalization of the CH).

    b. Survey is committed to – what does USACE/NMFS do if the *Acropora* is found during the survey during PED. If section 7 consultation is already complete, COE may need to reinitiate if colonies need to be re-located (since this would constitute take).

Attachments and Supplemental Information –

198 Monitoring Report – available on USACE FTP site –
ftp://ftp.saj.usace.army.mil/pub/Public_Dissemination/Port_Everglades_Feasibility_Study/Documents/Previous%20Deeping%20Project%20Documents%20-%201980

Key West Report – 2004-2006 Dredging

ftp://ftp.saj.usace.army.mil/pub/Public_Dissemination/Port_Everglades_Feasibility_Study/Meetings/02-Feasibility%20Phase%20Meetings/2007/Sept%2025%20&%2026%20HEA%20meeting/Other%20studies/Final%20RIAM%20Report%20Key%20West%202004-2006%20Dredge.pdf

Key West Report – 2007 Dredging

ftp://ftp.saj.usace.army.mil/pub/Public_Dissemination/Port_Everglades_Feasibility_Study/Meetings/02-Feasibility%20Phase%20Meetings/2007/Sept%2025%20&%2026%20HEA%20meeting/Other%20studies/RHSM%20Report%202007.pdf

Terri has photos of the TN rip rap and the JUL rip rap if NMFS is interested – can email under separate cover

UNITED STATES DEPARTMENT OF COMMERCE
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MAR 26 2008 F/SER31:AL

Ms. Marie Burns
Environmental Branch Chief – Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Ms. Burns:

The National Marine Fisheries Service (NMFS) Protected Resources Division (PRD) wishes to respond to numerous inquiries from your staff regarding the status of our biological opinion (BO) for the proposed Port Everglades dredging project in Broward County, Florida. As a cooperating agency for this project, we have reviewed and commented on the first version of the interim Draft Environmental Impact Statement (DEIS). Currently, the Corps of Engineers (COE) does not have an official proposed action for this project. In addition, we have not been provided with a draft mitigation plan. The proposed mitigation is part of the proposed action for the project and as such also needs to be considered for its effects on our species. It is quite possible that the scope of the proposed action may change depending on comments received from the cooperating agencies as well as comments received by the public once the DEIS is released for public comment.

We would like to reiterate the recommendations provided in our August 18, 2006, letter, a survey designed specifically to identify and quantify the presence and density of federally-listed acroporid coral colonies that may be present within or nearby the project area. We do not believe the information the COE has provided is sufficient to allow for an adequate review of the project's effects on these species. An analysis of the project's effects on listed corals based on the currently provided information would be arbitrary.

We are advising the COE that staghorn coral colonies have been documented approximately 3,500 feet south of the entrance channel to Port Everglades at JUL6, which is a permanent annual monitoring station for Broward County. Broward County Environmental Protection Department personnel have reported an increase in density of staghorn coral colonies at JUL6. This is supported by their data from 2004 and 2005, which showed an increase in density from 14 colonies per square meter in 2004 to 38 colonies per square meter in 2005. Examination of high resolution bathymetry for Broward County around Port Everglades indicates that the reef substrate that is characteristic of JUL6 appears to extend northward into the area of impact for the proposed project. Therefore, without a proper survey, it is reasonable to assume that staghorn coral colonies may occur closer than 3,500 feet from the entrance channel and may be present in close enough proximity to be adversely affected by turbidity and sedimentation from proposed dredging of the outer entrance channel.

In addition, NMFS has advised the COE (by e-mail dated February 6, 2008) that the extension of the Port Everglades outer entrance channel may affect proposed critical habitat for elkhorn and staghorn coral. We believe the primary constituent element (PCE) essential to the conservation of these species may be adversely affected by the proposed project. The proposed rule (50 CFR Parts 223 and 226) defines the PCE as "consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover…in water depths from mean high water to 30 meters." In Florida, Acropora critical habitat is proposed from the Dry Tortugas north to Palm Beach County, and includes substrate of suitable quality and availability in Broward County. We wish to reiterate that this project may affect proposed critical habitat for elkhorn and staghorn coral.

Based on the preceding, it would be premature for us to complete our draft biological opinion at this time. I propose you and I and our respective staffs meet at your earliest convenience to discuss moving forward on this high-profile project. If you have any questions, please contact me at (727) 551-5767, or by e-mail at David.Bernhart@noaa.gov.

Sincerely,

David M. Bernhart
Assistant Regional Administrator
for Protected Resources

cc:

F\SER47 - Jocelyn Karazsia
Chantal Collier, FDEP
Dr. Vladimir Kosmynin, FDEP
Erin McDevitt, FWC
Lisa Gregg, FWC
Ken Banks, Broward County EPD
Terri Jordan, COE Planning Division

Ref. F/SER/2002/00626
File: 1514-22.f.1.Fl

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

OCT 1 8 2006

Mr. David Bernhart
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
263 13th Avenue South
St. Petersburg, Florida 33701

Dear Mr. Bernhart:

The U.S. Army Corps of Engineers (Corps), Jacksonville District is currently conducting a feasibility study to assess Federal interest in navigation improvements throughout Port Everglades. This letter is in response to your letter dated August 18, 2006. The letter references the recently completed Port Everglades Reef Mapping and Assessment Preliminary Draft, and finds that in National Marine Fisheries Service's (NMFS) opinion "the study is flawed. It does not provide the Service with the best scientifically or commercial data available or which can be obtained for an adequate review of the effects that the action may have upon listed species..." Initiation of consultation for this action was by letter dated March 28, 2002.

The Corps' survey teams spent a total of 144 man hours in the water on the impact and control areas, as well as collected and reviewed more than 50 hours of video of the impact and control areas. The total impact area surveyed is 54.6 acres (the direct project footprint and an area to be assessed for possible indirect impacts). Other survey efforts for the project area include towed video and diver transect surveys in 2001 as part of the baseline report development (USACE, 2001); an October 2002 resource assessment conducted by a group of resource agency staff (including Michael Johnson of NMFS) and ongoing research efforts by scientists from Broward County DPEP and NOVA University (Broward County, 2001 and Gillem *et al.*, 2004). Given the amount of time spent in the water by all parties, the amount of video footage collected and analyzed, after discussions with Dr. Precht, the research team, and other Acroporid coral experts, the Corps believes that if a stand of either Acroporid coral, greater in age than 1-2 years (the age at which they become visible to the naked human eye (NMFS, 2005)) were located in the impact zone or the control areas, they would have been noted and recorded. To date, neither species have been recorded in or near the project area.

The NMFS recommends "An active and quantitative survey designed specifically to identify and quantify the presence and abundance of elkhorn and staghorn coral should be conducted for the proposed impact areas and control sites." Based on the surveys cited above, the Corps believes that there is sufficient data available to make a determination. It is possible that all of this combined survey effort has missed some small isolated acroporid corals. If such small isolated acroporid corals were present, the affect would be classified as insignificant or discountable, thus the basis of our June 2005 finding of "may affect, but not likely to adversely affect" is still valid.

NMFS cites the report's introduction that states the area was once "dominated" by Elkhorn coral as justification for the survey. The preceding sentence states "The reef communities that presently occur off Broward County cover drowned reefs formed during the Holocene". This was a citation from Lighty et al, 1978 which states "Radiocarbon dates obtained for the *Acropora palmata* facies indicate that the reef is Holocene in age, but has had no significant reef-framework accumulation for the past 6,000 years." The relic drowned reef at the mouth of the entrance channel at Port Everglades was built predominantly by *A. palmata* more than 6,000 years ago. Dr. Bill Precht has confirmed that neither *A.palmata*, nor *A.cervicornis* have been dominant on the reefs off of Broward County for about 6,000 years. The additional reference in the NMFS letter to documentation of *A.cervicornis* on the third reef dates back to a 1973 Goldberg reef survey off of Boca Raton, which is 22 miles north of the project area. However, a more recent study conducted by Gilliam *et al.* in 2004 throughout Broward County (with one of his survey areas – JUL #8 located 2,950 feet south of the proposed impact area) found no *A.cervicornis* on the third reef.

We understand the Service's concerns, and believe that we have addressed them. As part of the minimization and avoidance of impacts for the project, the Corps commit~~ments~~s to survey for and relocate any corals larger than 12 inches in size (30.48cm) prior to dredging the entrance channel extension. Should Acroporid species be found during this relocation effort, the Corps commits to relocating any *A.palmata* and *A.cervicornis* identified during the relocation surveys, even if they are less than 12 inches (30.48 cm) in size and reinitiating consultation with NMFS under Section 7 of the Endangered Species Act.

If you have any questions, please contact Ms. Terri Jordan at 904-232-1817 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

Marie G. Burns

Marie G. Burns
Chief, Environmental Branch

Enclosure

Memo for the Record - Effects Determination – Acropora Palmata
For ESA consultation with NMFS
Per request from Audra Livergood, NMFS-PRD – Miami, FL

The Corps has previously sent an affect determination for *Acropora palmata* and *A.cervicornis* under the ESA via an email to Mr. Juan Levesque of NMFS dated June 23, 2005. A summary of that email and a determination of direct impacts are included below.

<u>Indirect Effect –</u>
From June 2005 email - "Juan - after reviewing the "Broward County Shore Protection Project Geographic Information System database" that compiled all available data on offshore resources in Broward county (a copy of this 9-cd notebook was provided to NMFS as part of the BCSPP in 2001), the Corps has determined that the nearest *Acropora cervicornis* patch is located 21,277 feet (4.02 statue miles) north of the north jetty of the Port Everglades entrance channel, and the nearest *Acropora palmata* patch is located 46,405 feet (8.79 statue miles) north of the north jetty of the Port Everglades entrance channel. The Corps has photo documentation of a small patch of A. cervicornis to the south of the entrance channel within the boundaries of the John U. Lloyd State Park approximately 2,000 feet south of the south jetty that was not mapped by Broward County (from what we can determine). We are working to get a more detailed assessment of where this patch is located. However, since the current is this area is directly influenced by the Gulf Stream, it is unlikely that any sediment in the water column would move south of the channel, it is more likely it will move north under the influence of the South to North current. Also - due to the distance from the channel to the northerly mapped stands, it is also unlikely there will be any effect from the deepening project in the entrance channel from turbidity or sedimentation.

The Corps determines that the Port Everglades Feasibility Study, may effect, but is not likely to adversely affect either *Acropora cervicornis* or *Acropora palmata*, both currently proposed as threatened under the Endangered Species Act of 1973 and ask that NMFS concur with this determination in a conference opinion.

<u>Direct Effect –</u>
Per the recently finalized "Port Everglades Reef Report" completed on 10-10-2006 and provided to NMFS and other resource agency staff on 10-13-2006. The Corps' survey teams spent a total of 144 man hours in the water on the impact and control areas, as well as collected and reviewed more than 50 hours of video of the impact and control areas. The total impact area surveyed is 54.6 acres (the direct project footprint and an area to be assessed for possible indirect impacts). Other survey efforts for the project area include towed video and diver transect surveys in 2001 as part of the baseline report development (USACE, 2001); an October 2002 resource assessment conducted by a group of resource agency staff (including Michael Johnson of NMFS) and ongoing research efforts by scientists from Broward County DPEP and NOVA University (Broward County, 2001 and Gilliam *et al*., 2004). Given the amount of time spent in the water by all parties, the amount of video footage collected and analyzed, after discussions with Acroporid coral experts, the Corps believes that if a stand of either Acroporid coral, greater in age than 1-2 years (the age at which they become visible to the naked human eye (NMFS, 2005))

were located in the impact zone or even the control areas, they would have been noted and recorded. To date, neither species have been recorded in or near the project area.

However, it is possible that all of this combined survey effort has missed some small isolated Acroporid corals. If such small isolated Acroporid corals were present, the affect would be classified as insignificant or discountable, thus the basis of our June 2005 finding of “may affect, but not likely to adversely affect” would not change.

During discussions with NMFS-PRD, the Corps reiterated a commitment prior to dredging the entrance channel extension, to survey for and relocate any corals larger than 12 inches in size (30.48cm). During this survey, the Corps will commit to relocating any *A.palmata* and *A.cervicornis* identified during the relocation surveys, even if they are less than 12 in (30.48 cm) in size.

Literature cited

Broward County. 2001. Broward County Shore Protection Project Graphic Information Systems Database. Database and Instruction Manual for Complete 9 CD Version. December 2001.

Gilliam, D.S., R.E. Dodge, R.E. Spieler, L.K.B. Jordan, J.A. Monty. 2004. Marine biological monitoring in Broward County, Florida: Year 4 annual report. Technical Report DPEP 04-01. Ft. Lauderdale, Florida: Broward County, Board of County Commissioners.

National Marine Fisheries Service. 2005. *Acropora* Biological Review Team. 2005. Atlantic *Acropora* status Review Document. Report to the National Marine Fisheries Service, Southeast Regional Office. March 3, 2005. 152p+App.

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Planning Division
Environmental Branch

Mr. David Bernhart
National Marine Fisheries Service
Southeast Regional Office
Protected Species Resources Division
263 13th Avenue South
St. Petersburg, Florida 33701

Dear Mr. Bernhart:

The U.S. Army Corps of Engineers (Corps), Jacksonville District is currently conducting a feasibility study to assess Federal interest in navigation improvements throughout Port Everglades. This letter is in response to your letter dated August 18, 2006. The letter references the recently completed Port Everglades Reef Mapping and Assessment Preliminary Draft, and finds that in NMFS opinion “the study is flawed. It does not provide the Service with the best scientifically or commercial data available or which can be obtained for an adequate review of the effects that the action may have upon listed species…” Initiation of consultation for this action was by letter dated March 28, 2002.

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The NMFS recommends “An active and quantitative survey designed specifically to identify and quantify the presence and abundance of elkhorn and staghorn coral should be conducted for the proposed impact areas and control sites.” Based on the surveys cited above, the Corps believes that there is sufficient data available to make a determination. It is possible that all of this combined survey effort has missed some small isolated acroporid corals. If such small isolated acroporid corals were present, the affect would be classified as insignificant or discountable, thus the basis of our June 2005 finding of “may affect, but not likely to adversely affect” is still valid.

NMFS cites the report’s introduction that states the area was once “dominated” by Elkhorn coral as justification for the survey. The preceding sentence states “The reef communities that presently occur off Broward County cover drowned reefs formed during the Holocene”. This was a citation from Lighty et al, 1978 which states “Radiocarbon dates obtained for the *Acropora palmata* facies indicate that the reef is Holocene in age, but has had no significant reef-framework accumulation for the past 6,000 years.” The relic drowned reef at the mouth of the entrance channel at Port Everglades was built predominantly by *A. palmata* more than 6,000 years ago. Dr. Bill Precht has confirmed that neither *A.palmata*, nor *A.cervicornis* have been dominant on the reefs off of Broward County for about 6,000 years. The additional reference in the NMFS letter to documentation of *A.cervicornis* on the third reef dates back to a 1973 Goldberg reef survey off of Boca Raton, which is 22 miles north of the project area. However, a more recent study conducted by Gilliam *et al.* in 2004 throughout Broward County (with one of his survey areas – JUL #8 located 2,950 feet south of the proposed impact area) found no *A.cervicornis* on the third reef.

We understand the Services concerns, and believe that we have addressed them. As part of the minimization and avoidance of impacts for the project, the Corps commitments to survey for and relocate any corals larger than 12 inches in size (30.48cm) prior to dredging the entrance channel extension. Should Acroporid species be found during this relocation effort, the Corps commits to relocating any

A.palmata and *A.cervicornis* identified during the relocation surveys, even if they are less than 12 inches (30.48 cm) in size and reinitiating consultation with NMFS under Section 7 of the ESA.

If you have any questions, please contact Ms. Terri Jordan at 904-232-1817 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

Marie R. Burns
Chief, Environmental Branch

Enclosure

Jordan/CESAJ-PD-EC/1817/
Dugger/CESAJ-PD-EC
Ross/CESAJ-DP-C
Burns/CESAJ-PD-E

L: group/pde/jordan/Port Everglades Sec 7 response to Aug 18 2006 letter.doc

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Aronson, R.B., P.J. Edmunds, W.F. Precht, D.W. Swanson, and D.R. Levitan. 1994. Large-scale, long-term monitoring of Caribbean coral reefs: simple, quick, inexpensive techniques. Atoll Research Bulletin 421:1-19.

Aronson, R.B., and W.F. Precht. 1995. Landscape patterns of reef coral diversity: A test of the intermediate disturbance hypothesis. Journal of Experimental Marine Biology and Ecology 192:1-14.

Aronson, R.B., and D.W. Swanson. 1997. Video surveys of coral reefs: Uni- and multivariate applications. Proceedings of the 8th International Coral Reef Symposium 2:1441-1446.

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Lighty, R.G., MacIntyre, I.G. and Stuckenrath, R. (1978). Submerged early Holocene barrier reef south-east Florida shelf. Nature 276: 59-60.

Murdoch, T.J.T., and R.B. Aronson. 1999. Scale-dependent spatial variability of coral assemblages along the Florida Reef Tract. Coral Reefs 18:341-351.

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Section 7 Consultation Package –

US Fish and Wildlife Service

March 25, 2002

Planning Division
Environmental Branch

Mr. James J. Slack
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Slack:

The U.S. Army Corps of Engineers (Corps), Jacksonville District proposes to conduct a feasibility study to assess Federal interest in navigation improvements throughout Port Everglades. An evaluation of benefits, costs, and environmental impacts determines Federal interest. This Feasibility Study was authorized by a resolution of the House Committee on Transportation dated May 9, 1996.

The Recommended Plan's main elements include: widening and deepening (to –53/-50 feet) the Outer Entrance Channel, deepening the Inner Entrance Channel and Main Turning Basin to –50 feet, widening and deepening (to –47 feet) the Southport Access Channel, widening and deepening (to –32 feet) the Dania Cutoff Canal, constructing a Turning Basin at the intersection of the Dania Cutoff Canal and the Southport Access Channel at –32 feet, deepening a portion of the South Turning Basin to –44 feet, and widening and deepening (to –47 feet) the Turning Notch. Other significant construction items include relocation of the U.S. Coast Guard Basin (USCG) easterly within essentially USCG property, port facility construction, and environmental mitigation.

The Corps originally initiated consultation on this project on October 22, 1998 by sending a Biological Assessment to your office with a finding that the proposed project may affect, but was not likely to adversely affect manatees within the action area. On December 21, 1998, your office concurred with our finding. A copy of this original concurrence is included with this new assessment for your information.

The proposed project has changed significantly since this original consultation was concluded, and as a result, the Corps requests re-initiation of consultation under Section 7 of the ESA. Enclosed please find the Corps' biological assessment of the effects of the project as currently proposed on listed species and marine mammals in the action area and a copy of the draft EIS prepared for this proposed project.

After preparing this Biological Assessment of the impacts of the proposed project, the Corps has determined that the proposed project may affect, but is not likely to adversely affect the endangered Florida manatee (*Trichecus manatus*) found in the action area and we request that you concur with this finding.

If you have any questions, please contact Ms. Terri Jordan at 904-899-5195 or terri.l.jordan@saj02.usace.army.mil.

Sincerely,

James C. Duck
Chief, Planning Division

Enclosure

Copy furnished w/encl:

Dr. Robbin Trindell, Florida Fish and Wildlife Conservation Commission, Office of Environmental Services, Protected Species Management, 620 South Meridian Street, Tallahassee, Florida 32399-6000

Jordan/CESAJ-PD-EA/3453/
McAdams/CESAJ-PD-EA
Dugger/CESAJ-PD-E
Schwictenberg/CESAJ-DP-C
Strain/CESAJ-PD-P
Duck/CESAJ-PD

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BIOLOGICAL ASSESSMENT
PORT EVERGLADES NAVIGATION PROJECT
BROWARD COUNTY, FLORIDA

Description of the Proposed Action

The U.S. Army Corps of Engineers (Corps) proposes to expand and deepen Port Everglades Harbor. A detailed description of the proposed project and all alternatives considered under the Feasibility Study are evaluated in the Draft Environmental Impact Statement enclosed with this Biological Assessment. Broward County requested that the Corps study the feasibility of widening and deepening most of the major channels and basins within Port Everglades. Four major improvement goals were identified. 1) Improve transit in the Outer Entrance Channel (OEC), Inner Entrance Channel (IEC), Main Turning Basin (MTB) and Southport Access Channel (SAC) to accommodate liquid bulk, cruise, and container vessels; 2) Develop the DCC (DCC) to accommodate mid-size container vessels; 3) Deepen the North Turning Basin to accommodate Panamax (and larger) size container ships; and 4) Improve turning and berthing in the Turning Notch (TN).

The purpose of the proposed action is to provide increased safety, efficiency and lower costs for future port navigation and utilization, while protecting the environment. The proposed action resulted from a comprehensive analysis of all the existing and future commercial vessel transit needs within the port. This economic analysis has shown that improvements to most of the major Federal and non-Federal channels and basins are required to achieve efficient transit of the existing fleet, and to accommodate the future fleet. Substantial liquid bulk cargo cost savings can be achieved by deepening the OEC, IEC, and MTB. Widening of the OEC flare will allow safer transit for all the larger commercial vessels that experience sometimes troublesome cross currents at the channel entrance. Removal of the Widener Shoal and widening of the SAC allows for more efficient and safer transits of containerized cargo vessels past the Knuckles restriction where new generation cruise vessels are expected to be berthed. Lengthening and deepening of the TN will provide turning possibilities for larger vessels and will provide critical berthing for containerized cargo vessels. Deepening of the STB will allow for more efficient use Berths 16-18 by allowing Panamax vessel calls. Finally, widening and deepening of the DCC (in addition to a turning basin located adjacent to the SAC) will allow for relocation of smaller and midsize container, roll on/roll off (ro/ro) vessels, and general cargo traffic, thereby reducing congestion in the areas serviced by larger vessels.

The Corps expects the construction to be performed using a variety of methods including blasting and dredging with a cutterhead, clamshell or other type of dredge. Any blasting that will occur within the project will be confined blasting. Confined blasting is defined as a blast where the explosives had been placed in a hole bored into the rock substrate and capped with 3-4 feet of crushed rock known as “stemming”. Stemming forces the explosive blast downward into the rock instead of allowing the blast to expand into the water column.

Action Area

The Port Everglades Harbor is a major seaport located on the southeast coast of Florida. It is located within the cities of Hollywood, Dania Beach and Fort Lauderdale, with immediate access to the Atlantic Ocean. The entrance of the Port is approximately 27 nautical miles north of Miami Harbor, Florida and 301 nautical miles south of Jacksonville Harbor, Florida. Figure 1 shows the location of the project site.

Figure 1 - Location of Project

The existing Port Everglades Federal Navigation Project provides for an Outer Entrance Channel (OEC) that is 45 feet deep and 500 feet wide, an Inner Entrance Channel (IEC) that is 450 feet wide and 42 foot deep, a Main Turning Basin (MTB) that is 42 feet deep, a North Turning Basin (NTB) that is 31 feet deep, a South Turning Basin that is (STB) 31 to 36 feet deep, a Southport Access Channel (SAC) that is 390-400 feet wide and 42 feet deep, and a Turning Notch (TN) that is 42 feet deep. To the east of the port is a barrier island that contains a U.S. Navy facility, a NOVA Southeastern University facility, a U.S. Coast Guard facility, and John U. Lloyd State Recreation Area and its adjacent beaches. South of the port's DCC is the Westlake Park area. West of the port is Federal Highway which is flanked by the Fort Lauderdale/Hollywood International Airport. North of the port is a mixture of small craft waterways and commercial and residential development.

Protected Species Included in this Assessment

Of the listed and protected species under FWS jurisdiction occurring in the action area, the Corps believes that only the Florida manatee (*Trichecus manatus*) may be affected by the implementation of the Navigation Project. Although there is designated critical habitat for the Florida manatee throughout south Florida, the action area is not located within this designated habitat (50 CFR 17.95).

The Federal government has recognized the threats to the continued existence of the Florida manatee for more than 30 years. The West Indian manatee was first listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (16 U.S.C. 668aa(c)) (32 FR 48:4001). The Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa(c)) continued to recognize the West Indian manatee as an endangered species (35 FR 16047), and the West Indian manatee was also among the original species listed as endangered pursuant to the Endangered Species Act of 1973. Critical habitat was designated for the manatee in 1976. The justification for listing as endangered included impacts to the population from harvesting for flesh, oil, and skins as well as for sport, loss of coastal feeding grounds from siltation, and the volume of injuries and deaths resulting from collisions with the keels and propellers of powerboats. Manatees are also protected under the provisions of the Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 1361 *et seq*.) and have been protected by Florida law since 1892. Florida provided further protection in 1978 by passing the Florida Marine Sanctuary Act designating the state as a manatee sanctuary and providing signage and speed zones in Florida's waterways.

Species and suitable habitat descriptions

Status and Distribution of the Florida manatee

All manatees belong to the Order Sirenia. The living sirenians consist of one species of dugong and three species of manatee. A fifth species, the Steller's sea cow, was hunted to extinction by 1768. The Greek name for this order is derived from the sirens of Greek mythology. Sirens were female, partly human creatures that lured ships onto the rocks by their mesmerizing songs.

All living sirenians are found in warm tropical and subtropical waters. The West Indian manatee was once abundant throughout the tropical and subtropical western North and South Atlantic and Caribbean waters. However, the manatee's numbers have been greatly reduced. Today the West Indian manatee is listed as an endangered species throughout its range.

Habits

Florida manatees are herbivores that feed opportunistically on a wide variety of submerged, floating and emergent vegetation. Shallow grass beds with ready access to deep channels are the preferred feeding areas in coastal and riverine habitats. Bengtson (1983) estimated that the annual mean consumption rate for manatees feeding in the upper St. John's Ricer at 4% to 9% of their body weight per day depending on season. A complete review of manatee biology is included in the manatee section of the South Florida Multi-species Recovery Plan (FWS, 1999) and will not be repeated here.

Distribution

The manatee occurs throughout the southeastern United States. The only year-round populations of manatees occur throughout the coastal and inland waterways of peninsular Florida and Georgia (Hartman 1974). During the summer months, manatees may range as far north along the East Coast of the U.S. as Rhode Island, west to Texas, and, rarely, east to the Bahamas, FWS 1996, Lefebvre *et al.* 1989). There are reports of occasional manatee sightings from Louisiana, southeastern Texas, and the Rio Grande River mouth (Gunter 1941, Lowery 1974).

In Florida, manatees are commonly found from the Georgia/Florida border south to Biscayne Bay on the east coast and from Wakulla River south to Cape Sable on the west coast (Hartman 1974, Powell and Rathbun 1984) (Figure 1). Manatees are also found throughout the waterways in the Everglades and in the Florida Keys. Although temperatures are suitable for manatees in the Florida Keys, the low number of manatees has been attributed to the lack of fresh water (Beeler and O'Shea 1988). Manatees also occur in Lake Okeechobee.

In warmer months (April to November), the distribution of manatees along the east coast of Florida tends to be greater around the St. Johns River, the Banana and Indian rivers to Jupiter Inlet, and Biscayne Bay. On the west coast of Florida, larger numbers of manatees are found at the Suwannee, Crystal and Homosassa rivers, Tampa Bay, Charlotte Harbor/Matlacha Pass/San Carlos Bay area, the Caloosahatchee River and Estero Bay area, the Ten Thousand Islands, and the inland waterways of the Everglades. On the west coast, manatee's winter at Crystal River, Homosassa Springs, and other warm mineral springs (Powell and Rathbun 1984, Rathbun *et al.* 1990). In the winter, higher numbers of manatees are seen on the east coast at the natural warm waters of Blue Spring and near man-made warm water sources on or near the Indian River Lagoon, at Titusville, Vero Beach, Ft. Pierce, Riviera Beach, Port Everglades, Ft. Lauderdale, and throughout Biscayne Bay and nearby rivers and canals (FWS 1996). They also aggregate near industrial warm water outflows in Tampa Bay, the warmer waters of the Caloosahatchee and Orange rivers (from the Ft. Myers power plant), and in inland waters of the Everglades and Ten Thousand Islands.

Habitat preferences

The Florida manatees inhabit rivers, bays, canals, estuaries, and coastal areas rich in seagrass and other vegetation. They can live in fresh, saline (salt), and brackish water. They move freely between salinity extremes. Manatee may be found in any waterway over 3.25 ft. (1 m) deep and connected to the coast. They prefer water above 70 degrees F (21 degrees C). Florida manatees rarely venture into deep ocean waters. However, there are reports of manatees in locations as far offshore as the Dry Tortugas Islands, approximately 50 mi. (81 km) west of Key West, Florida. The patchy distribution of manatees throughout all their ranges is due to the distribution of suitable habitat: plentiful aquatic plants and a freshwater source.

Migration

Florida manatees move into warmer waters when the water temperature drops below about 68 degrees F (20 degrees C). The geographic distribution of manatees within Florida has changed since the 1950s and 60s (Lefebvre *et al.* 1989) and prominent shifts in seasonal distribution are also evident. Before man introduced warm effluents from power plants to the natural environment in the early 1950s, the winter range of the manatee in Florida was most likely limited on its northern bounds by the Sebastian River on the east coast and Charlotte Harbor on the west coast (Moore 1951). Since that time, manatees altered their normal migration patterns and appreciable numbers of manatees began aggregating at new sites. As new power plants became operational, more and more manatees began taking advantage of the sites by traveling great distances just to bask in the warm waters. Among the most important of the artificial warm-water discharges are the Florida Power and Light Company's power plants at Cape Canaveral, Fort Lauderdale, Port Everglades, Riviera Beach, and Fort Myers, as well as the Tampa Electric Company's Apollo Beach power plant in Tampa Bay, Florida. These artificially heated sources have allowed manatees to remain north of their historic wintering grounds. They may have replaced natural warm water springs destroyed or made inaccessible through human development. More than 200 manatees have been reported at some power plants during cold weather. The introduction of power plants and paper mills in northern Florida, southern Georgia, Louisiana, and Texas has given manatees the opportunity to expand their winter range to areas not previously frequented (Hartman 1979). However, warm water industrial discharges alone are not suitable alternatives to the natural warm water refugia provided by natural springs because they usually lack the vegetation necessary to sustain the manatees.

Status of the species

Determining exact population estimates or trends is difficult for this species. The best indicator of population trends is derived from mortality data and aerial surveys (Ackerman *et al.* 1992, Ackerman *et al.* 1995, Lefebvre *et al.* 1995). Aerial surveys conducted for more than 20 years have shown an increase in numbers, but this information is not an accurate account of trends since data has been obtained using different survey methods. O'shea (1988) found no firm evidence of a decrease or increase between the 1970s and 1980s, even though aerial survey counts have increased. Increases in the number of recovered dead manatees have been interpreted as evidence of increasing mortality rates (Ackerman *et al*. 1992, Ackerman *et al.* 1995). Because manatees have low reproductive rates, these increases in mortality may lead to a decline in the population (O'shea *et al.* 1988, 1992).

Although there are no accurate estimates of manatee population size, the Florida Department of Environmental Protection's (DEP) 1996 aerial surveys conducted from February 18-19, determined there were at least 2,639 manatees in Florida's waters. DEP conducted two surveys in 1997. The January survey determined that 2,229 manatees were present in Florida's waters:

900 on the east coast and 1,329 manatees on the west coast. The February survey determined that 1,709 manatees were present in Florida's waters: 791 manatees on the east coast and 918 on the west coast. Surveys conducted by DEP in 1996 and 1997 determined that numbers of manatees on the east coast and west coasts of Florida are almost equal (Rathbun *et al.* 1992). These estimates represent the minimum number of manatees in Florida waters and may not represent the total population size. As of the January 2001 census, the minimum Florida manatee population was 3,276 (FWRI 2002).

Mortality
Despite the lack of accurate estimates of the manatee population size, human activities have significantly affected manatees by eliminating or modifying suitable habitat, altering migratory access routes, increasing mortality, and decreasing abundance, all of which in turn, can affect manatee reproduction, recruitment, distribution, and behavior. To understand manatee mortality trends in Florida, Ackerman *et al.* (1995) evaluated the number of recovered carcasses between 1974 and 1992 and categorized the causes of death. During that time interval, the number of manatees killed in collisions with watercraft increased each year by 9.3 percent. The number of manatees killed in collisions with watercraft each year correlated with the total number of pleasure and commercial watercraft registered in Florida (Ackerman *et al.* 1995). Other human-related threats include manatee death or injury from flood-control structures and navigational locks, entanglement in fishing line, entrapment in culverts, and poaching. These other threats accounted for 162 known mortalities between 1974 and 1993 (FRMI 2002a). Deaths from flood control structures and other human-related deaths did not change significantly but deaths due to these categories decreased more than deaths from other causes.

Table #2 – Statewide manatee mortalities – FRMI – Marine Mammal Pathology Lab database

Year	Watercraft	Flood Gate/ Canal Lock	Other Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
1974	3	0	2	0	0	0	2	0	7
1975	6	1	1	7	0	1	10	3	29
1976	10	4	0	14	0	2	22	10	62
1977	13	6	5	9	0	1	64	16	114
1978	21	9	1	10	0	3	34	6	84
1979	24	8	9	9	0	4	18	5	77
1980	16	8	2	13	0	5	15	4	63
1981	24	2	4	13	0	9	62	2	116
1982	20	3	1	14	0	41	29	6	114
1983	15	7	5	18	0	6	28	2	81
1984	34	3	1	25	0	24	40	1	128
1985	33	3	3	23	0	19	32	6	119
1986	33	3	1	27	12	1	39	6	122
1987	39	5	2	30	6	10	22	0	114
1988	43	7	4	30	9	15	23	2	133
1989	50	3	5	38	14	18	39	1	168
1990	47	3	4	44	46	21	40	1	206
1991	53	9	6	53	1	13	39	0	174
1992	38	5	6	48	0	20	45	1	163
1993	35	5	6	39	2	22	34	2	145
1994	49	16	5	46	4	33	37	3	193
1995	42	8	5	56	0	35	53	2	201
1996	60	10	0	61	17	101	154	12	415
1997	54	8	8	61	4	42	61	4	242
1998	66	9	6	53	9	12	72	4	231
1999	82	15	8	53	5	37	69	0	269
2000	78	8	8	58	14	37	62	8	273
2001	81	1	7	61	32	33	108	2	325

Of interest is the increase in the number of perinatal deaths. The frequency of perinatal deaths (stillborn and newborn calves) has been consistently high over the past 5 years. This estimate may not be a true representation of the actual number of perinatal deaths that occur because the carcasses of these young animals may not be recovered. The cause of the increase in perinatal deaths is uncertain, but may result from a combination of factors that includes pollution, disease, or environmental change (Marine Mammal Commission 1992). It may also result from the increase in collisions between manatees and watercraft because some newborn calves may die when their mothers are killed or seriously injured by boat collisions, when they become separated from their mothers while dodging boat traffic, or when stress from vessel noise or traffic induces premature births (Marine Mammal Commission 1992). As a result of the high perinatal death rate, there are fewer young age classes present in the population.

Of the 1,907 manatee carcasses that have been recovered in Florida between 1989 and 1997, (DEP 1998) nearly half were female. The reduction of mature females places an additional burden and pressure on younger, less-experienced females to be the foundation for population growth. Younger females may be more apt to abandon their calves and less successful in calf rearing (Marine Technical Advisory Council 1994). A loss of mature, experienced males may also reduce the likelihood of successful mating. The greatest present threat to manatees is the high rate of manatee mortalities caused by watercraft collisions. O'Shea *et al.* (1985) recognized the dramatic increase in the rate of boat use in manatee habitat and, consequently, the increase in the potential of boat-related manatee injury or death. Between 1986 and 1992, watercraft collisions accounted for 37.3 percent of all manatee deaths, where the cause of death could be determined (Ackerman *et al.* 1995). The significance of manatee mortalities related to watercraft appears to be the result of dramatic increases in vessel traffic. Ackerman *et al.* (1995) showed a strong correlation between the increase in recorded manatee mortality and increasing boat registrations. In 1960, there were approximately 100,000 registered boats in Florida; by 1990, there were more than 700,000 registered vessels in Florida (Marine Mammal Commission 1992, Wright *et al.* 1995). Approximately 97 percent of these boats are registered for recreational use. The most abundant number of registered boats is in the 16-foot to 26-foot size class. Between 1974 and 1997, there were 3,270 known manatee mortalities in Florida. Of these, 749 were watercraft-related. Since 1974, an average of 31 manatees have died from watercraft-related injuries each year; between 1983 and 1993, manatee mortalities resulting from collisions with watercraft reached record levels (DEP 1994). Approximately twice as many manatees died from impacts suffered during collisions with watercraft than from propeller cuts; this has been a consistent trend over the last several years. Medium or large-sized boats cause most lethal propeller wounds, while impact injuries are caused by fast, small to medium-sized boats (Wright *et al.* 1992). Watercraft-related mortalities were most significant in the southwest and northeast regions of Florida; deaths from watercraft increased from 11 to 25 percent in southwestern Florida. In all of the counties that had high watercraft-related manatee deaths, the number of watercraft and the seasonal abundance of manatees were high (Ackerman *et al.* 1995).

Action area status information

Historical records regarding manatees in Broward County are sparse. Manatees are mentioned in documents that are dated as early as the mid 1800's and early 1900's (O'Shea 1988). Moore (1951) references observations told to him of common manatee use of the New River. It is unknown if these early accounts of manatees were associated with the Lauderdale Power Plant which began operations in 1926 (Mezich 2001). Prior to the Broward county power plants, Dade County may have been important historically to wintering manatees. Moore (1951) also notes the importance of the Miami River, including the 1943 anecdotal observation of more than 100 manatees killed during the deepening of the Miami River Channel and his 1956 reference of 195 manatees aggregating at the Miami power plant discharge (Mezich 2001). Additionally, the rivers, creeks and canals that open into Northern Biscayne Bay were locations noted for their manatee abundance.

Power plant usage as warm water refuge

Hartmann (1974) reported that an aggregation of as many as 30 manatees used the lower reaches of Port Everglades power plant's discharge canal during the early 1970's. The first organized aerial counts occurred in 1976 when the U.S. Fish and Wildlife Service funded them (Irvine and Campbell 1978). During the first survey on January 30, 1976, 78 manatees including 10 calves were counted in Broward County, all but two located at a power plant (Irvine and Campbell

1978). Since 1977, Florida Power and Light (FPL) has continued winter aerial surveys of at all of their coastal power plants. The increasing numbers of manatees counted at the Port Everglades plant during the early and mid 1970'a may have been a result of two factors. First, as noted by Rose and McCutcheon (1980) the Miami River Power plant closed in 1973, where Moore (1956) estimated as many as 195 manatees aggregated during the winter. Secondly, during the same time frame the FPL-Lauderdale plant was beginning to operate less consistently, which may have discouraged manatees from this site.

Data prior to 1993 corresponds with later information that manatees have favored the Port Everglades facility over the Lauderdale plant. The USGS-Sirenia Project radio tagged 71 manatees and monitored their movements over a 12-year period from 1986 to 1998. Seventeen of these individuals visited the Port Everglades facility as opposed to 5 visiting the Lauderdale facility. Additionally, in 1986 a total of 124 individual manatees had been cataloged at Port Everglades by photographic records of distinctive scar patterns (Reid and Rathburn 1995).

Mezich (2001) believes that the manatee preference for the Port Everglades may be changing. The Lauderdale plant repowered in 1993 and began operating more consistently. Since that time, manatees have used this plant in greater numbers (Reynolds 2000). The numbers of manatees using the Lauderdale plant has grown to a point, where for the first time on a January 2000 synoptic survey, more manatees were counted at the Lauderdale plant than at the Port Everglades plant – 124 to 111 respectively. During the 2001 survey the Lauderdale plant had an all time high count of 143 animals. Reynolds (2000b) noted this interesting change in behavior, "the importance of certain locations can change dramatically over time, and it provides some empirical data on this timing of transitions". The growing preference for the Lauderdale plant, maybe due to the new consistency of warm water in the cooling canals in conjunction with the lack of human disturbance. Reynolds also speculates that this preference would be manifested primarily in females and calves. In 1999-2000 the FPL-Lauderdale had the highest increase in calves for all plants.

The warm-water refuge at the Port Everglades plant is located approximately 7-miles seaward of the Lauderdale plant. Beeler and O'Shea (1988) concluded that in Broward County, the Lauderdale and Port Everglades power plants were the only areas known to be used in numbers by manatees. Despite the fact that these plants are located well within the manatee's winter range, it is debatable as to the level of importance of the Broward County power plants to the winter survival of manatees. Only two cold stress deaths have been recorded in Broward County since 1974 (Mezich 2001). Although the number of cold related deaths is low, this indicates that manatees are not immune to cold weather in southeastern Florida. In addition to being warm-water refugia, these power plants offer respite from heavily trafficked waterways, incidents of human-related harassment.

Manatees that aggregate at the FPL plants in Broward County are known to travel between the Lauderdale and Port Everglades plants as well as other warm-water refugia on the on the east coast of Florida (Deutsch 2000 and MMC 1998). The high single day winter manatee counts for these warm-water are: FPL-Lauderdale (143) and FPL-Port Everglades (276). The last five annual survey counts done at FPL-Lauderdale and FPL-Port Everglades have shown a great deal of variability. Several factors can affect these aerial counts (i.e. weather conditions that affect manatee distribution and poor water clarity). Table #2 presents all of the aerial survey data for FPL-Port Everglades from 1977-2001.

Table #2 – Aerial survey abundance data for FPL-Port Everglades

Survey year	FPL-Port Everglades High Count
1977-1978	114
1978-1979	125
1979-1980	86
1980-1981	110
1981-1982	57
1982-1983	56
1983-1984	35
1984-1985	234
1985-1986	185
1986-1987	182
1987-1988	276
1988-1989	173
1989-1990	227
1990-1991	75
1991-1992	212
1992-1993	70
1993-1994	224
1994-1995	207
1995-1996	13
1996-1997	60
1997-1998	183
1998-1999	60
1999-2000	134
2000-2001	290

Source – Mezich 2001

Foraging

During the winter, water temperature is a primary factor that dictates when manatees leave warm-water refugia and where they forage. Manatees that winter at the Broward county power plants are foraging primarily on aquatic vegetation in Dade County (Mezich 2001). Distribution and abundance of freshwater aquatic vegetation in the area of Broward County power plants is relatively limited and relegated to vegetation growing in canals or on the shoreline, including overhanging plants and trees. In freshwater environments in Dade County, manatees are feeding primarily on the exotic *Hydrilla verticillata*.

Even though manatees may travel in excess of 20 miles to get to foraging areas in Dade County, this is not inordinately farther than distances traveled by manatees on the west coast of Florida to get from warm water refugia to foraging grounds.

Mortality

The causes for manatee deaths in Broward County are varied; however, Broward County does not have any cause of death category that ranks as one of the highest in the state. Deaths related to cold stress have been almost non-existent over the past 25 years of record keeping, with only three being reported in that time period. Port Everglades is well within the historic range for the Florida manatee described by Moore (1951b). Water temperatures seldom reach stressing levels for extended periods of time and the power plants in Broward County have likely ameliorated cold related stress. Table #3 depicts the manatee mortalities reported for Broward County since 1974.

The highest number of manatee deaths in Broward County result from watercraft interactions. Over half of the deaths related to this category are concentrated within a 1.5-mile radius of Port Everglades. The amount of deaths in this area is likely due to high recreational and commercial vessel traffic converging with a manatee travel corridor. In the vicinity of these deaths there are two power plants, an inlet, a port, and a major manatee migration corridor (Mezich, 2001).

Broward County has also had six floodgate deaths since 1974, but only one in the last five years. Floodgates often have qualities that are attractive to manatees. Freshwater is often available at floodgates as are slightly warmer the ambient water temperatures. An example of this situation is the floodgate on the Little River in Dade County. This site is known to attract manatees during mild portions of winter. This location has a 1-degree Celsius higher water temperature than surrounding areas and freshwater is available (Deutsch 2000). Also, freshwater vegetation is often washed down from upriver and made available when the gates are opened. Overall, Broward County ranks 10th out of 43 counties that have documented manatee deaths.

The Corps and the South Florida Water Management District (SFWMD) have identified 17 water control structures in Broward County needing to have manatee protection devices installed. The Corps will be starting work on two of these structures (S-13 and S-33) in the near future (Overstreet, pers. comm. 2002). The locations of all water control structures in Broward County, operated by the SFWMD, are shown in Figure 2. Structure S-13 is located on the DCC, and by placing the manatee protection device at this structure, manatees transiting the DCC will be less likely to die as a result of crushing or entrapment in the structure.

Figure 2 - Locations of Water Control Structures in Broward County

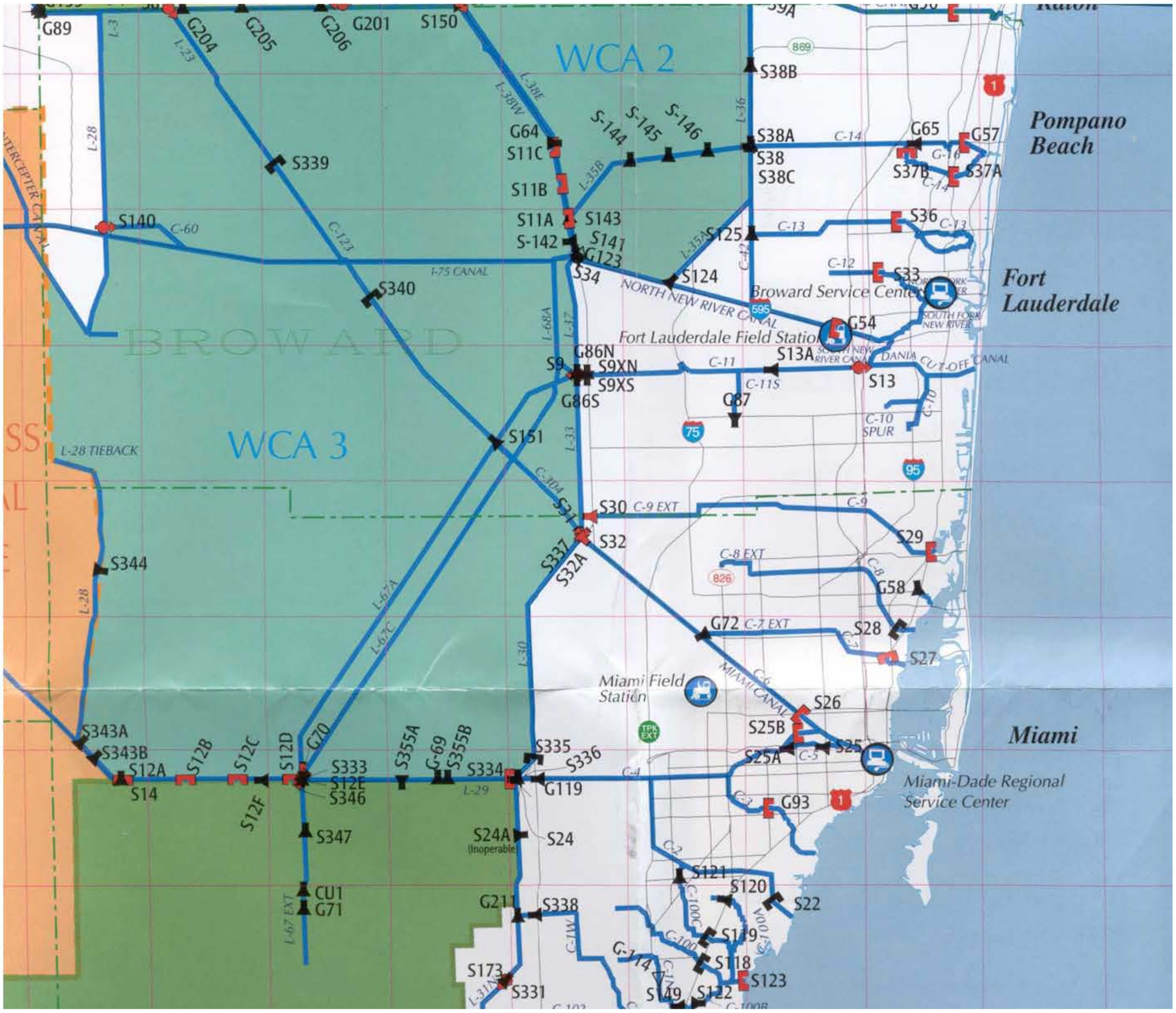


Table #3 – Manatee deaths in Broward county 1974-2001

Year	Watercraft	Flood Gate/ Canal Lock	Other Human	Perinatal	Cold Stress	Natural	Undetermined	Unrecovered	Total
1974	0	0	0	0	0	0	1	0	1
1975	1	0	0	0	0	0	0	0	1
1976	1	0	0	0	0	0	0	0	1
1977	0	0	1	1	0	0	2	0	4
1978	0	0	0	1	0	0	0	1	2
1979	0	0	0	0	0	0	2	0	2
1980	2	1	0	2	0	0	1	4	10
1981	1	0	0	0	0	0	1	0	2
1982	2	1	0	0	0	0	1	0	4
1983	1	0	0	0	0	1	0	0	2
1984	2	0	0	0	0	0	3	0	5
1985	0	1	2	0	0	0	1	0	4
1986	2	0	0	2	1	0	0	1	6
1987	5	0	0	0	0	0	1	0	6
1988	2	0	0	0	1	1	0	0	4
1989	3	0	1	1	0	0	0	0	5
1990	1	0	0	0	0	0	0	0	1
1991	2	1	0	0	0	0	0	0	3
1992	2	0	0	5	0	0	2	0	9
1993	2	0	0	1	0	0	1	0	4
1994	3	0	0	1	0	0	0	0	4
1995	0	1	0	4	0	0	0	0	5
1996	1	0	0	2	0	2	2	0	7
1997	0	0	0	1	0	2	2	0	5
1998	2	1	0	2	0	2	2	0	9
1999	5	0	0	4	0	5	5	0	19
2000	2	0	0	1	0	1	1	0	5
2001	4	0	0	3	1	0	0	0	8

Description of suitable manatee habitats within the action area

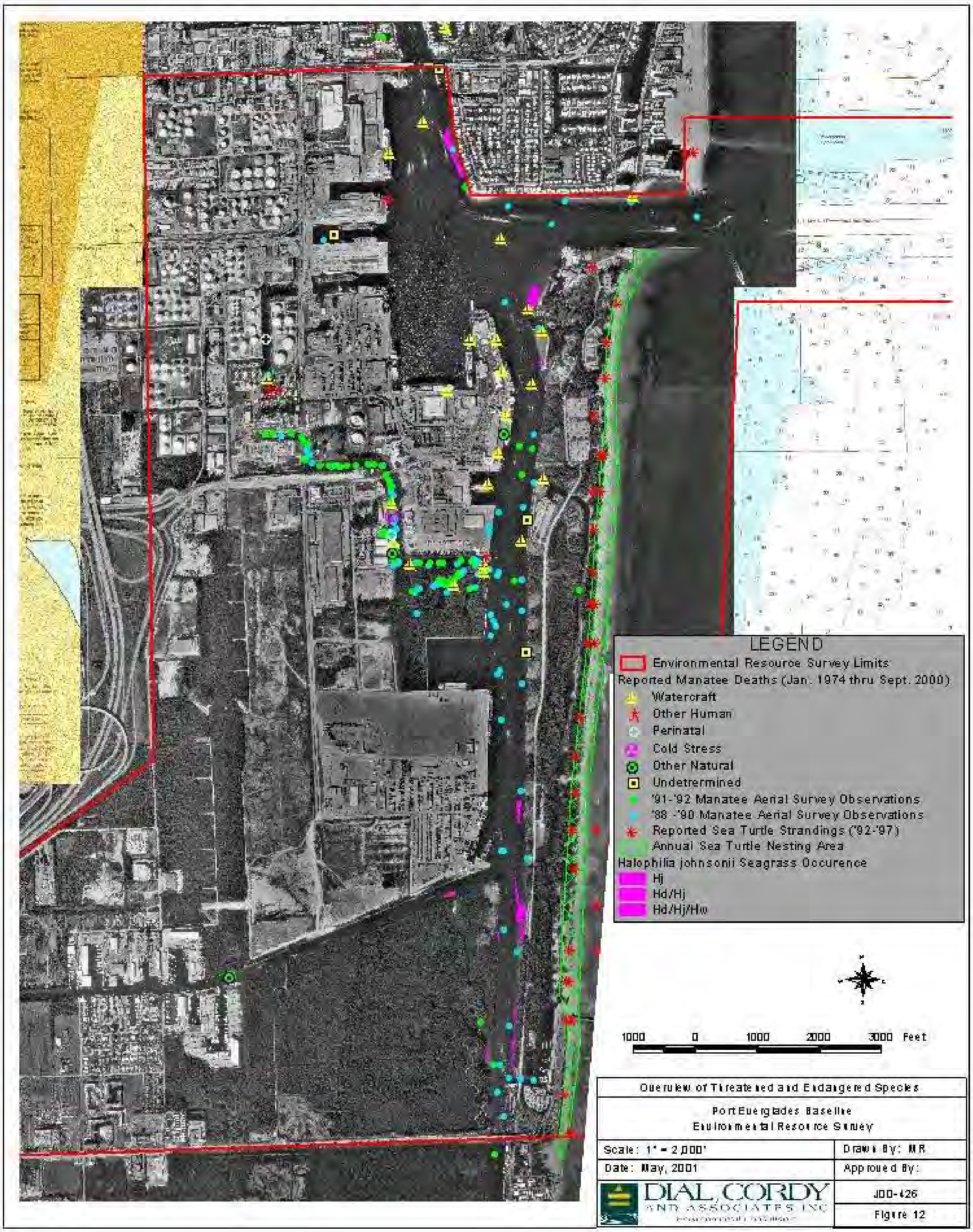
Manatees occur in both fresh- and saltwater habitats within tropical and subtropical regions. They depend on areas with access to natural springs or manmade warm water and access to areas with vascular plants and freshwater sources. Several factors contribute to manatee distribution. These factors are habitat-related and include proximity to warm water during cold weather, aquatic vegetation availability, proximity to channels of at least 2m in depth, and location of fresh water sources (Hartman 1979).

Manatees are also dependant upon location of foraging sites. As previously discussed, radio-tracking of manatees at the Port Everglades power plant has shown that they transit south, into Dade county to forage due to the lack of foraging area available to them near the power plant.

Manatees often seek out quiet areas in canals, lagoons or rivers. These areas provide habitat not only for feeding, but also for resting, cavorting, mating, and calving. Deeper channels are often used as migratory routes (Kinnaird 1983). Manatees seek out natural or artificial freshwater sources, especially manatees that spend time in estuarine and brackish water (FWS 1996).

The former “EPA slip” within the Port has been identified as an area of high manatee useage, and has been documented as a site utilized by calving mothers (Port Everglades, 2002). Figure #3 displays the location of manatees sighted during aerial surveys conducted from 1988 – 1992.

Figure 3 – Manatee locations – Aerial Surveys



Protective Measures taken in the project area separate from conservation measures the Corps will take as part of the proposed action

Port Everglades

Port Everglades has taken numerous steps to reduce manatee-human interaction, injury and mortalities within the port. The port has spent more than $600,000 to increase protective measures for manatees within the port (Sosnow 2002 pers.comm). These steps have included:

- Posting of manatee warning and speedzone signage throughout the Port.
- The Port desigated the former “EPA slip” in the FPL discharge canal as a “Manatee Nursery Area” to restrict the area’s use from boaters and the general public. The area has been documented as a site utilized by calving mothers (Port Everglades 2002).
- Development and implementationof a Manatee protection plan for use during dredging for use during dredging activites within the Port.
- Development and implementation of a Manatee protection plan for use during blasting activites within the Port.
- Manatee Lagoon Improvements – the Port deepened tha lagoon and the water below the mangroves adjacent to the FPL canal. Thes improvements allow manatees to stay in the lagoon during all tidal stages; as well as increasing flushing of warm water into the area. The port also placed floating barricades and signage to keep the public out of the area. The area has been documented as a site utilized by calving mothers (Sosnow 2002 pers.comm.).
- Lagoon Protection at the John U. Lloyd State Recreation Area.
- Funding of research on manatees within the port conducted by the FWS and the Miami Seaquarium and other researchers (White, Reynolds, Fleetameyer).
- Participation in law enforcement activities to prevent harrassment of manatees by individuals swimming with them.
- Each year before the manatee “season” (Nov 15-Mar 31) begins, the Port sends letters to tug companies and pilots reminding them about the upcoming season and about the protective measures that the port has implemented to protect manatees in the port.
- The port has placed fenders throughout the entire port at 50 ft centers to fender off ships – when a ship is tied to the bulkhead, the fender is approximately 4 feet in width. These fenders prevent manatees from being crushed between the ships and the bulkhead walls.
- Development of outreach programs and materials including brochures, seminars and public talks. The port opened a platform/sea life viewing area to educate the public about the manatees and other animals that are in the port. 400,000 people visited the platform in one year. This viewing area caused traffic and parking problems near the port and had to be closed.

Broward County

Broward County is one of 13 Florida counties required to have a manatee protection plan developed under the Local Government Comprehensive Planning and Land Development Regulation Act (LGCPALDRA) of 1985. The LGCPALDRA requires these plans include speed and no entry zones, boat facility siting policies and other measures to protect manatees. Broward

County has prepared a plan, and incorporated it into the county's "Comprehensive Plan". These plans are submitted to the State, through the Florida Fish and Wildlife Conservation Commission, and to the Federal government through the US Fish and Wildlife Service. As of November 2001, neither the state nor the USFWS had approved the Broward County plan (USFWS 2001). The county's Manatee protection element of the comprehensive plan is located in the "Conservation Component" of the plan (Chapter 13, book 2).

Speed & No Entry Zones
Seasonal no-entry zones around the power plants were created in 1979 and amended in 1983. A Broward County wide speed zone rule was adopted in May 1993 (68C-22.010, Florida Administrative Code). Placement of speed zone signage for the Broward County rule was completed in October 1994. The County has worked with FPL to restrict or prohibit access to certain waterways and waterbodies that appear to be manatee high use areas.

Boating facility Siting Policies
The LGCPALDRA requires "manatee" counties to prepare policies concerning the siting of boating facilities. The County has not taken an approach to boat facility siting since it is considered built out (Arnold 2001). New facilities are likely to be conversions of either existing property to multifamily residential or the redevelopment of commercial facilities to accommodate larger vessels usually by lowering the number of slips at a site (Arnold 2001). Therefore, new boat facility development and the expansion or conversion of of existing facilities will be reviewed for impacts to manatees and their habitat through normal state permitting. The County will provide guidance to potential boat facility developers by guiding them to be consistent with the plan and to incorportate Best Management Practices within their application.

Designation of Essential Habitat for Manatees within the County
Broward County has identified areas to be designated as essential habitat: the FPL plant discharge areas; Port and Whiskey Creek; the Hollywood Canal; the residential canals located approximately one quarter mile west of the Florida Turnpike and immediately north of I-595 (Plantation Isles subdivision), and the Hillsborough Inlet (Arnold, 2001).

Scientific Research on Manatees
Regulations developed under the ESA allow for the taking of ESA-listed manatees for the purposes of scientific research. In addition, the ESA also allows for the taking of listed species by states through cooperative agreements developed per section 6 of the ESA. Prior to issuance of these authorizations for taking, the proposal must be reviewed for compliance with section 7 of the ESA. Research permits for manatees are issued by the FWS' headquarters in Arlington, VA (Valade 2002 pers.com). Research activities currently conducted under permit from FWS in the action area include:

- Photo identification study of manatees by the USGS-Sirenia project
- Photo identification study by Dr. Ed Keith of NOVA University
- Carcass recovery and necropsy activities conducted by the State of Florida through the Florida Marine Research Institute's Marine Mammal Pathology Laboratory.

Other consultations of Federal actions in the area to date

The Corps has been working with the citizens of Broward County since 1930 on improving and maintaining Port Everglades Harbor (USACE 2002). The following table lists the improvements authorized by Congress. None of the projects authorized by Congress through 1958 were required to consult under the ESA, it is unknown if a consultation under Section 7 of the ESA was conducted on the 1974 project.

ACTS	WORK AUTHORIZED	DOCUMENTS
3 Jul 1930	Maintenance of harbor constructed by local interests.	H. Doc. 357/71/2
30 Aug 1935	Enlarge entrance channel to existing project dimensions and complete turning basin to 1,200 feet square.	R. & H. Comm. Doc. 25/74/1
20 Jun 1938	Widen turning basin 350 feet on north side.	H. Doc. 545/75/3
24 Jul 1946	Widen turning basin 200 feet on north side, 500 feet on south side, and enlarge flare at entrance channel.	H. Doc. 768/78/2
3 Jul 1958	Deepen and widen entrance channel on a new alignment and increase turning basin in size and depth.	H. Doc. 346/85/2
H.R. 9 May 1974 S.R.31 May 1974	Deepen and widen entrance channel on a new alignment, deepen turning basin and add a new channel to the southeast of the turning basin. This project was completed in 1984.	H. Doc. 144/93/1

Projects completed by the Port without Federal assistance

1987	Port Everglades. Final Environmental Impact Statement, Proposed Expansion Port Everglades, Broward County, Florida. EIS for deepening and widening the Southport Access Channel, bulkheading port land, creation of the Turning Notch. This project was completed

Effects of the proposed action

Direct effects

As previously stated, during winter months a large population of manatees uses the warm water refuge at the FP&L Power Plant at Port Everglades and at the Lauderdale power plant at the end of the DCC.

The highest potential to directly effect endangered manatees may be the use of explosives to remove areas of rock within the Entrance Channel and Southport Access Channel. Both the pressure and noise associated with blasting can injure marine mammals. Noise and pressure effects to manatees have not been well documented, however, it is assumed that manatees will be impacted similar to dolphins, where documentation is available.

Blasting

To assess and reduce the effects of blasting on endangered, threatened and otherwise protected species, the Corps contracted with Dr. Calvin Konya, Precision Blasting Services, to review previous Corps blasting projects, recommendations of Florida Fish and Wildlife Conservation Commission (FFWCC) (then known as the Florida Department of Natural Resources) and the U.S. Fish and Wildlife Service (FWS) prepared for a harbor deepening project at Port Everglades, Florida conducted in the mid 1980's. A copy of this plan has been previously provided to the FWS during coordination activities on this action.

<u>Historic Blasting in Port Everglades and Manatee Protections</u>
During the consultation process on the 1983 blasting in Port Everglades, the FWS and FFWCC recommended that a formula proposed by Johnson, Commander, USN and Project Manager and Coordinator of OICC TRIDENT.

An arc having a radius defined by delineated the danger zone:

$$D = (13000\ W^{1/3})/P$$

Where:

D = radius of the danger zone in feet
W = weight of the explosive charge in pounds
P = overpressure created by the explosion shockwave, where
P = 50 psi+ ambient pressure

However, it was later pointed out by an expert in blasting and dredging activities that this formula could not be applied to the Port Everglades blasting project because it was based on an unconfined blast instead of a confined blast. An unconfined blast is defined as an open air or open water blast without any physical restrictions that will slow down its development. A confined blast is usually associated with drilling and blasting within the restrictions of rock strata. As a result of this information, the consultation group rejected the formula.

Alternatively, the physical parameters used during an ongoing dredge project in Kings Bay, Georgia. The physical parameters of distance vs. overpressure for the Kings Bay project were determined by a test blasting conducted between 28 June and 2 July 1983 at Kings Bay, Georgia. Assuming a water overpressure of 50 psi or less would not harm a manatee, the results of the test program indicated that this overpressure would not be exceeded at a distance of 400 feet given a blast of 780 pounds of explosives per day. The Corps also decided to extend the blasting danger zone to 600 feet to ensure a safety margin.

To adequately ensure the safety of manatees while blasting, a 14-point plan was developed. Agencies involved in designing this plan include FFWCC, FWS, the Corps and the Florida Audubon Society. The manatee protection program used during the Port Everglades harbor deepening project in the mid-1980's was successful and will be used as a model in the upcoming project.

Aerial surveys were conducted prior to the beginning of the blasting project. A Bell helicopter was used to survey the Port area on three consecutive days prior to the beginning of the blasting. Provisions were included in a "Manatee Protection Plan" stated that if more than five (5) animals were observed on those surveys, the project would be delayed until the number of animals fell below five. The surveys were flown at ground speed, which ranged between 10 kts and 60 kts and at an altitude that ranged between 50 meters and 200 meters.

Results of the 1983 blasting in Port Everglades

During the period between 4 April and 8 May when this program was in operation, a total of 58 manatee sightings were made on 28 separate occasions were made. A table of these observations is included in Konya (2001) (Table #2). Three of these sightings were made with the fathometer, while the remaining 25 were visual observations made by either the boat observer or observers stationed on the drill barge.

These observations necessitated shutting down the blasting operation for a total of 14 times and for a total of 222 minutes, the average time being 15 minutes, 12 seconds. On April 19, 1984, because of the number of manatees observed near the dynamite drill barge, the operation was shut down prematurely and was not resumed until the next day.

Possibility for injury or mortality in mammals in the project area

To protect mammals (manatees and dolphins), the following relationship has been used in the past and has been into previous Corps dredging projects. This formula is based on the Navy Diver Formula, which is designed for unconfined charges.

$$\text{Caution zone radius} = 260(\text{lbs/delay})^{1/3}$$

$$\text{Safe zone radius} = 520(\text{lbs/delay})^{1/3}$$

The caution zone is the radius from the blast where mortality will not occur.

New data obtained from the 1983 Port Everglades blasting project indicates that the Navy Diver Formula is extremely conservative for predicting safe distances from the charges that are placed in boreholes. In his report, Koyna (2001) proposes a new formula that incorporates actual measurements of pressures generated from underwater blasts with explosives in boreholes. The new equation is:

$$\text{Caution zone} = 132(\text{lbs/delay})^{1/3}$$

$$\text{Safe zone radius} = 56(\text{lbs/delay})^{1/3}$$

The Corps plans to utilize this new formula in the proposed blasting at Port Everglades. Additionally, the Corps will prepare a marine mammal and sea turtles protection plan similar to the one used in the previous deepening project will be employed. Based on the previous mid-1980 program a 600 feet safety zone will be used. Trained, experienced observers would monitor the safety zone by helicopter, high vantage points, and boat. Examples of the provisions to be included in the protection plan are included below:

In order to provide dependable verification of presence of manatees within the blast zone, a detection system was designed which included the following three provisions:

- Provision 7: A trained observer will be stationed on the sighting tower or catwalk of the dynamite drill barge.

- Provision 8: An observer in a boat will make a systematic survey of the danger zone prior to blasting.

- Provision 9: An electronic color enhanced fathometer will be utilized to monitor underwater manatee movement.

Additionally, special conditions will be placed into the specifications for the project to protect manatees in the area.

1. A marine mammal watch will be conducted by no less than 2 qualified observers from a small watercraft, at least ½ hour before and after the time of each detonation, in a circular area at least three times the radius of the above described danger zone (this is called the watch zone).
2. Any marine mammal(s) in the danger zone or the watch zone shall not be forced to move out of those zones by human intervention. Detonation shall not occur until the animals(s) move(s) out of the danger zone on its own volition.
3. No blasting will occur in the south channel during the “manatee season”.
4. In the event a marine mammal or marine turtle is injured or killed during blasting, the Contractor shall immediately notify the Contracting Officer as well as the following agencies:
    a. Florida Marine Patrol "Marine Mammal Stranding Hotline" 1-800-342-5367
    b. FWS – Vero Beach Office
    c. National Marine Fisheries Service – Protected Resources Division, St. Petersburg

Other Rock Removal Options

The Corps investigated methods to remove the rock in Port Everglades without blasting using a punchbarge. It was determined that the punchbarge, which would work for 12-hour periods, strikes the rock below approximately once every 30-seconds. This constant pounding would serve to disrupt manatee behavior in the area, as well as impact other marine animals in the area. Using the punchbarge will also extend the length of the project temporally, thus increasing any potential impacts to all fish and wildlife resources in the area.

The Corps believes that blasting is actually the least environmentally impactful method for removing the rock in the Port. Each blast will last no longer than 25 seconds in duration, and may even be as short as 2 seconds, and will be spaced out twelve hours apart. Additionally, the blasts are confined in the rock substrate. Boreholes are drilled into the rock below, the blasting charge is set and then the chain of explosives is detonated. Because the blasts are confined within the rock structure, the distance of the blast effects are reduced as compared to an unconfined blast.

Indirect effects

The regulations for interservice consultation found at 50 CFR 402 define indirect effects as "are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur". The Corps does not believe that the project will have any indirect effects on manatee in the action area.

Effects of interrelated and interdependent actions

The regulations for interservice consultation found at 50 CFR 402 define interrelated actions as "those that are part of a larger action and depend on the larger action for their justification" and interdependent actions as "those that have no independent utility apart from the action under consideration."

The Corps does not believe that there are any interrelated actions for this proposed project; however, the recommended plan for Port Everglades contains widening components and deepening components. As a result of the widening components of the project, larger container vessels will call at Port Everglades. As a result of both the widening and the deepening components of the project, more tonnage will be carried per vessel call, so the total number of vessel calls will be reduced (Dawedit 2002. pers comm.). This will be an indirect benefit to the manatees since there will be fewer ships in the area to potentially affect them. Additionally, the wider channel will provide manatees more room to maneuver around incoming and outgoing vessels throughout the action area.

The Corps believes that the increase in size within the Port will not have an adverse effect on manatees in the area for three reasons:

1) Recent data shows that manatees are not using the Port itself as a primary habitat. Aerial surveys conducted between 1988-1992 show that very few manatees use the area of the Port proper. They congregate in the canal to the Port Everglades power plant, as well as in the "EPA slip" – both of which are located south of the Port (Figure 2);
2) The Port has developed a manatee protection plan and implemented items included in the plan – including the placement of 4-ft wide bumpers along the slips to hold ships 4-feet away from the bulkheads, thus reducing the potential for a manatee to be crushed by a ship; The Port has also put into place regulations drafted by the state that requires ships to travel at the slowest speed possible that maintains steerage, and
3) Fewer manatees are utilizing the Port Everglades power plant as a winter thermal refuge – so there are fewer animals in the area that could be affected by the project.

Cumulative effects
The regulations for interservice consultation found at 50 CFR 402 define cumulative effects as "those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consideration." The Corps is not aware of any future state or provate activites, not involving Federal activities that are reasonably certain to occur within the action area."

Take Analysis
Due to the restrictions and special conditions placed in our construction specifications the Corps does not anticipate any take of the endangered Florida manatee.

Determination
The Corps has determined that the proposed expansion and deepening of Port Everglades Harbor is likely to affect, but not likely to adversely affect listed species within the action area. The Corps believes that the restrictions placed on the blasting previously discussed in this assessment will diminish the effect of the project on protected species within the action area.

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